SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor, J. McKeen Cattell, Garrison-on-Hudson, N. Y.

DANIEL GARRISON BRINTON.

THE Memorial meeting in honor of the late Dr. Daniel Garrison Brinton was held at the hall of the Historical Society of Pennsylvania on the evening of the 16th of January, under the auspices of the American Philosophical Society, by twenty-six learned societies. The societies represented at the meeting were:

Academy of Natural Sciences of Philadelphia.
American Antiquarian Society.
American Association for the Advancement of Science.
American Folk Lore Society.
American Museum of Natural History.
American Oriental Society.
American Philosophical Society.
Anthropological Society of Washington, D. C.
Bureau of American Ethnology.
Chester County Historical Society.
Field Columbian Museum.
Geographical Society of Philadelphia.
Historical Society of Pennsylvania.
Jefferson Medical College.
Loyal Legion.
Modern Language Association of America.
New Jersey Historical Society.
Numismatic and Antiquarian Society of Philadelphia.
Oriental Club of Philadelphia.
Peabody Academy of Science.
Peabody Museum of American Archæology and Ethnology.
Smithsonian Institution.
United States National Museum.
University of Pennsylvania.
Wyoming Historical and Geological Society.

The program of the meeting was as follows:

1. Introductory by the presiding officer, representing the American Philosophical Society, by Provost Charles C. Harrison.
2. Presentation of an oil portrait of Dr. Brinton, the gift of friends to the American Philosophical Society, by Hon. Samuel W. Pennypacker.
3. Acceptance on behalf of the American Philosophical Society, by Dr. J. W. Holland.
4. Memorial Address, by Professor Albert H. Smyth.
5. Presentation of a collected set of Dr. Brinton's works, the gifts of his family to the American Philosophical Society, by Rev. Jesse Y. Burk.
6. Acceptance in behalf of the American Philosophical Society, by Mr. Joseph G. Rosengarten.
7. Address by Major J. W. Powell, of Washington, D. C.
8. Presentation of a medal bearing Dr. Brinton's portrait in relief, the gift of the Numismatic and Antiquarian Society to the American Philosophical Society, by Mr. Stewart Culin.
9. Acceptance on behalf of the American Philosophical Society, by Dr. J. Cheston Morris.
10. Address on the Ethnological Work of Dr. Brinton, by Dr. W J McGee, of Washington, D. C.

The meeting was called to order by provost Charles C. Harrison of the University of Pennsylvania and letters of regret were read from Major J. W. Powell, Miss Alice C. Fletcher, Mr. Frank Hamilton Cushing, The Marquis de Nadaillac and others.

Provost Harrison in his opening address, after eulogizing Dr. Brinton's attainments and services to science, referred to his gift to the University of Pennsylvania, before his death, of his priceless library of books on American languages and suggested that a Professorship of American Archæology be founded at the University to bear the title of the 'Brinton' chair.

The portrait of Dr. Brinton, presented by a number of his friends to the American Philosophical Society, was painted by Thomas Eakins, an artist who had known Dr. Brinton intimately.

The presentation of the portrait was made by the Hon. Samuel W. Pennypacker, Vice-President of the Historical Society of Pennsylvania, and accepted by Dr. J. W. Holland, Dean of the Jefferson Medical College, where Dr. Brinton had received his medical education. Professor Albert H. Smyth then delivered the Memorial address which was followed by the presentation to the American Philosophical Society by the Rev. Jesse Y. Burk of a complete set of Dr. Brinton's published works, a gift to the Society from Mrs. Brinton.

Major Powell was unable to be present on account of illness and his place on the program was assigned to Professor F. W. Putnam who urged the foundation of a memorial chair of Anthropology in the University of Pennsylvania in honor of Dr. Brinton, "covering the whole subject in the broad way which Dr. Brinton himself covered it in his lectures to students."

Mr. Culin then presented in behalf of the Numismatic and Antiquarian Society of Pennsylvania a bronze medal of Dr. Brinton cast by Mr. John Flanagan an American artist in Paris, and struck by the Society in commemoration of the 40th anniversary of its existence and the 15th of Dr. Brinton's presidency.

After the acceptance of the medal by Dr. Cheston Morris, on behalf of the American Philosophical Society, Dr. W J McGee delivered an address on the ethnological work of Dr. Brinton.

The meeting was largely attended, the societies participating sending delegates who were present.

A full report of the proceedings will be published in the Memorial Volume of the Philosophical Society which is about to go to press, and an edition of the part relating to the Brinton meeting will be printed and bound separately for distribution to libraries and institutions. This book will contain a bibliography.

THE FACILITIES AFFORDED BY THE OFFICE OF STANDARD WEIGHTS AND MEASURES FOR THE VERIFICATION OF ELECTRICAL STANDARDS AND ELECTRICAL MEASURING APPARATUS.

THE need of adequate facilities for the official verification of standards and measuring apparatus of all kinds, has long been recognized by American physicists. The Office of Weights and Measures, with its small force, modest equipment and insufficient appropriations, has endeavored to meet any demands imposed upon it within the limits thus set.

The object of this article is to describe what has thus far been accomplished along electrical lines, and in this connection a brief history of the units of reference may not be considered out of place.

The origin of standards of quantity and value dates back as far as the earliest historical records. The transition from the crude measures of antiquity to the systems meeting present requirements has, however, been exceedingly slow, although the growth of commercial intercourse gradually led to the introduction of more precise standards.

The requirements of accuracy were, nevertheless, quite modest until physics began to emerge from its qualitative stage to assume the dignity of an exact science.

The number and complexity of physical quantities at first led to the adoption of more or less arbitrary standards of reference, often based on the physical properties of some definite substance, *e. g.*, the calorie, and as long as the relations between physical quantities remained obscure, such relative standards sufficed. With the development of the science came the recognition of the desirability of a consistent system of units, which was strongly brought to the front, when it became necessary to measure magnetic quantities.

The happy solution of this problem suggested by Gauss and extended to the measurement of electrical and electro-magnetic quantities by Weber, constituted a great advance in the science of Metrology, the units being defined in terms of the mechanical actions to which they give rise. Since all mechanical units can be expressed in terms of three independent fundamental units, such as those of length, mass and time, the magnetic and electrical units of Gauss and Weber are thus expressible in terms of the same fundamental units and are therefore entirely independent of the physical properties of arbitrarily chosen substances. Hence they are called absolute units, their magnitudes depending solely on the choice of the fundamental units.

The units of length and mass selected were usually multiples or sub-multiples of the corresponding metric units, the metric system being the only one meeting the highest scientific and practical requirements and being already in extensive use. While at first uniformity in the selection of the magnitudes of the fundamental units was lacking, the centimeter, gram and second have now been universally adopted, the derived units being known as C. G. S. units.

Practical measurements of electrical resistance were, however, first referred to a variety of arbitrary standards, *e. g.*, the resistance of a given length of copper or iron wire of given diameter, and so long as electrical measurements were confined to the laboratory, the length referred to was usually a few feet, but with the practical applications of electricity to telegraphy and submarine signaling, this length became inconveniently small and was therefore replaced by fathoms, miles, etc. Fortunately none of these units ever gained general acceptance. In 1848 Jacobi pointed out that it would be far preferable to adopt, as a universal standard, the resistance of a certain piece of wire, copies *having the same resistance* being easily constructed.

Jacobi carried this suggestion into practice by sending a piece of copper wire, since known as 'Jacobi's Étalon' to various physicists for that purpose.

In 1860 Werner von Siemens proposed as a standard of resistance, the resistance, at 0°C., of a column of mercury, 1 sq. mm. in cross section and 100 cm. in length.

In 1861 a committee, composed of the most eminent English physicists was appointed by the British Association to consider the question of Standards of Electrical Resistance. Correspondence was opened with the leading foreign physicists and various special investigations of the problems, with which the committee was confronted, were undertaken by its members.

The first question settled was that the unit of resistance should be defined as a multiple by an integral power of 10 of the unit of Weber's absolute system, and that the unit chosen should be of a convenient magnitude. Accordingly, a unit equivalent to 10^9 C. G. S. units was adopted.

This definition fixed the unit, but the evaluation of a resistance in absolute measure requires the construction of especially designed apparatus, having usually a limited range of usefulness; the determination of instrumental constants, most frequently involving tedious mathematical approximations, and in addition, the observations have to be made with the greatest precision. On the other hand, relative measurements require simpler apparatus and less skill in manipulation, besides being, in most cases, far more accurate than absolute measurements. The construction of material standards adjusted to the specified resistance, determined once for all by a series of absolute measurements, was therefore decided upon.

Investigations were made to determine whether the absolute unit of resistance could be accurately defined in terms of the resistance of a definite portion of a definite substance. Pure metals in the solid and liquid state and alloys were studied with this end in view. On account of the excessive influence on the resistance produced by small quantities of impurities in metals and by small variations in the composition of alloys and on account of the additional difficulty of procuring chemically pure materials, the choice was greatly limited. Moreover solids had to be rejected on account of the marked effect of physical changes produced by drawing, bending, annealing, etc.

Mercury, already recommended by Siemens, was therefore the only material to be further considered. Even this material was rejected, owing to large differences found to exist between coils, supposedly adjusted to agree with different German mercury standards, and the mercury standards constructed by members of the committee.

Having abandoned the above propositions, the alternative remained of constructing material standards adjusted with reference to the absolute unit.

A number of new alloys, in addition to many already in use, were made and investigated. An alloy of 2 parts by weight of silver to 1 part by weight of platinum was finally selected as best meeting all requirements. A special form of resistance standard was also adopted.

In 1863 and 1864 the values of certain coils were determined in absolute units by one of the methods proposed by Weber and from these measurements the B. A. unit was derived. A number of copies were issued gratis by the Association and in addition arrangements were made to furnish others at a moderate price. The B. A. unit soon gained universal acceptance in the English speaking countries, while the Siemens unit still retained its supremacy on the continent.

In 1878 it was shown by Professor Rowland that the B. A. unit differed from its

assumed value by more than one per cent. and soon after, this difference was substantiated by a number of other investigators.

In 1881 a call was issued, in connection with the first Paris electrical exhibition, for an international electrical congress for the purpose of adopting definitions of the electrical units to serve as a basis for legislative enactments. Numerous mercury standards had in the meantime been constructed and had been found to agree most satisfactorily with one another; moreover, the results of a considerable proportion of the absolute determinations made had been referred, directly or indirectly, to the Siemens unit. In view of this, the Paris Congress passed a resolution recommending that all absolute determinations in the future be expressed as the resistance of a column of mercury of stated length, 1 sq. mm. in cross section at the temperature of melting ice, and that the C. G. S. electro-magnetic system of units be adopted. The desirability of making new determinations of the ohm was urged.

Three years later the Congress reassembled at Paris and adopted 106 cm. as the length of the specified column of mercury, individual results still differing by as much as $\pm .5$ per cent. The unit of resistance thus defined was called the legal ohm, but while it was never legalized anywhere, it nevertheless came into extensive use, especially in England and in America.

Absolute methods were gradually improved, sources of error were pointed out, and eliminated as far as possible and accordingly the results of absolute determinations, made by the most radically different methods, became more concordant.

The International Electrical Congress (which met in Chicago in 1893), through its Chamber of Delegates, officially representing all the leading governments, therefore adopted, as the unit of resistance, the mean of all the best determinations, the resistance at 0° C. of a column of mercury 106.3 cm. in length and of uniform cross section having a mass of 14.4521 gm. (equivalent to a cross section of 1 sq. mm., the density of mercury being assumed to be 13.5956). The unit of resistance and the other electrical units defined by the International Congress were legalized in the United States by Act of Congress in 1894, and have also been legalized in the other countries represented.

It was generally supposed that the various governments would sooner or later take up the construction of mercury standards as called for in the definition since each had already been provided by the International Bureau of Weights and Measures with the fundamental standards of mass and length.

The Imperial Physico-Technical Reichsanstalt in Berlin has already begun this task with its characteristic thoroughness: Two one ohm mercurial standards were constructed and later, a third together with a $\frac{1}{2}$ and a two ohm tube. Widely different cross sections were purposely selected to avoid possible sources of error. The calibration and intercomparison of these standards leaves almost nothing to be desired, measurements made by two different methods, both yielding the same results within the limits of experimental error.

Twelve mercury copies were also constructed; these, together with 7 working standards of manganin wire, periodically referred to the primary standards, complete the list.

In England, on the other hand, the B. A. coils have still been retained as primary standards. The legal ohm was defined in that country by the relation, 1 Siemens unit = .9540 B. A. units, and later the International Ohm was defined by the relation, 1 Siemens unit = .95351 B. A. units. According to a comparison made several years ago, 1 Siemens unit, as derived from the Reichsanstalt Standards, is equal to .95341

B. A. units, indicating a change in the coils themselves, or in their assumed relation to the Siemens unit or in both.

Matters have been still further complicated in England by the legalization of the resistance of a coil marked 'Board of Trade Standard verified 1894,' and adjusted with reference to the Cambridge Standards, as the unit of resistance.

A still more radical suggestion was made in that country several years ago, by Professor A. Viriamu Jones and Professor W. E. Ayrton, that each government adopt a Lorenz apparatus from which to derive by absolute measurements the unit of resistance. The practical substitution of an absolute method with its disadvantages as pointed out above, for a purely relative one seems to be taking a step or indeed several steps backward, but may be taken as indicating the lack of confidence in the permanency of the B. A. coils.

After the legalization of the International Electrical Units it became the imperative duty of our government to provide facilities for the official verification of electrical standards and electrical measuring apparatus, especially in view of the continually increasing importance of the applications of electrical energy to the industral arts. This function obviously devolved upon the Office of Standard Weights and Measures, already equipped for the verification of standards of length, mass, capacity, etc.

Owing, however, to the limited force and to the still more limited appropriations available for the purchase of apparatus, practically nothing could be done until July 1, 1897, when the appointment of a verifier was authorized, but unfortunately progress has frequently been interrupted for long periods by the pressure of routine work.

It was determined from the outset that it should be the aim of the Office to provide facilities for measurements to any degree of accuracy likely to be set even by the most exacting demands of modern science. The first steps taken by the Office consisted in working out a general plan and providing the most needed apparatus and facilities.

STANDARDS OF RESISTANCE.

To avoid the delay which would naturally arise from the construction of primary mercury standards, it was decided to refer all measurements of electrical resistance to the mean value of a number of wire coils, known in terms of the best existing mercury standards. The general excellence of coils of the Reichsanstalt type, the extremely small temperature coefficients and thermo-electromotive power with respect to copper of manganin and the permanency of coils of that material as shown by long continued observations at the Reichsanstalt, decided in favor of standards of the above description.

Four unit coils were purchased and were standardized at the Reichsanstalt where they were kept under observation for about one month, during which period they decreased in value by about .0015%. This, according to the maker, is the normal behavior of the material which undergoes, after the artificial aging, a small decrease in resistance followed by a slow increase. In addition to these coils the Office possesses two other coils of the same type purchased several years ago. Periodic intercomparisons between the old coils and the new ones will be made so that any relative changes will be made manifest, the two hardly having the same rate of change. Two new manganin coils have been ordered and are also to be referred to the German Standards. On their receipt, they will furnish us positive evidence in regard to any changes which may have taken place in the preliminary standards adopted. The approximate corrections at any time can then be determined by simple interpolation.

To fix this standard, the construction of

a number of mercury copies will also be taken up. The construction of primary mercury standards, which is of fundamental importance, not only from a scientific standpoint but also on account of the legal questions which will surely arise, will be undertaken as soon as time permits.

The Office has acquired in addition to the unit coils, standards of the following denominations:

1	2	Ohm
1	5	"
4	10	"
4	100	"
3	1,000	"
2	10,000	"
2	100,000	"
3	0.1	"
3	0.01	"
3	0.001	"
3	0.0001	"

The temperature coefficients of these coils were first carefully determined, then the coils of the same denomination were intercompared and the observations reduced to differences at 20° C.

The next step consisted in determining the resistance of the multiples and submultiples in terms of the unit. Thus, two unit coils placed in series by means of a connecting link of known resistance were compared with the two ohm coil. The five and ten ohm coils were similarly evaluated in terms of the unit. From the known ratio of a 10 ohm coil to one of the units, the step can be made to the 100 ohm coils by means of a second ten ohm coil also known in terms of the unit. Similarly the values of the coils of still higher value were determined and those of the sub-multiples of the unit, by a slightly modified method.

THE METHOD OF COMPARISON ADOPTED.

The practice in this country and in England has been overwhelmingly in favor of the Carey Foster method, but the construction of the Reichsanstalt standards, with their terminals 16 cm. apart, makes the use of the Carey Foster Bridge almost out of the question. The design of a suitable bridge capable of comparing coils of this type with those having a different distance between the terminals, introduces still further complications. Moreover, in the Carey Foster method, additional resistances are introduced in the mercury cups of the commutator which are only eliminated in a perfect mechanical construction. Besides the resistances connecting the coils to the commutator, unless equal, are *not* eliminated. While the Carey Foster method is at first glance superior in being a zero method, the Wheatstone Kelvin Bridge, more simple and far less expensive in construction, excels the former especially where the intercomparison of low resistance standards is concerned, provided the coils to be compared are first made nearly equal by means of a shunt of known value applied to the greater. The value of the shunt need not even be known to a high degree of accuracy in case of fairly well adjusted coils.

The coils are connected to one another by copper forgings 1.5 cm. thick and 2 cm. wide, having therefore a resistance of about 0.6 micro-ohm per cm. of length, their terminals resting in mercury cups. To permit the comparison of coils differing widely from the standards, provisions have been made to enable one of the coils compared, to be placed in parallel with an accurately known coil by means of a second pair of mercury cups.

The sources of error characteristic of the direct deflection method are due to the following causes:

(1) Variation of E. M. F. of test battery.

(2) Variation of galvanometer sensibility, due either to the variation of proportionality between deflection and current, or to a change in the actual sensibility.

These only affect the deflection corresponding to the unbalanced *differences* in the ratios of the coils intercompared so that even if the errors in interpolation should be relatively large, the error in the ratio will be exceedingly small. With the ratios adjusted by means of shunts to within $\frac{100}{1000000}$ of equality an error of 1%, 5 to 10 times that actually existing, would produce an error of one part in 1,000,000 in the calculated ratio of the coils compared.

The Wheatstone-Kelvin bridge entirely eliminates the resistance of the parts connecting the lower mercury cups of these coils by means of shunting a second ratio coil across the resistance to be eliminated, the battery contact being transferred to its middle point. The inequality of the two halves of the ratio coil is eliminated by its reversal. The remaining sources of error are possible variable contact resistances in the mercury cups and possible differences in the insulation resistances between them. The bottoms of the cups are accurately surfaced and these sources of error are shown to have no importance by interchanging the positions of the two coils compared. Thermo-electromotive forces are eliminated by battery reversal. The heating effect of the test current was shown to be quite negligible, less than $\frac{1}{10000000}$ for a current of .03 ampere for one ohm manganin coils, since a current of 1 ampere through such a coil produces a heating of the coil above the temperature of the petroleum bath in which the comparisons are made, of approximately 1°C.

A specimen of the results which may be obtained under rather unfavorable conditions is given below. Four one ohm coils were intercompared in the 6 possible combinations, 6 additional measurements being made with the left and right coils interchanged with the following results:

L	R	Observed Differences.	Cal. Diff.	Residuals Obs.-Cal.
1402	1403	$= -3.8 \times 10^{-6}$ ohm	−3.8	0.0
R	L			−0.1
1402	1403	= −3.9		
L	R			
1402	1404	= −4.6	−3.7	−0.9
R	L			
1402	1404	= −2.8		+0.9
L	R			
1402	1405	= −0.8	−0.8	0.0
R	L			
1402	1405	= −1.0		−0.2
L	R			
1403	1404	= +0.2	−0.2	+0.4
R	L			
1403	1404	= −0.6		−0.4
L	R			
1403	1405	= +3.4	+3.0	+0.4
R	L			
1403	1405	= +2.5		−0.5
L	R			
1404	1405	= +3.4	+3.2	+0.2
R	L			
1404	1405	= +3.0		−0.2

Since resistance comparisons can be made to such a very high order of accuracy, to within $\frac{1}{500}$% at least, even in the case of properly designed .0001 ohm standards, all interested may assure themselves that every effort will be made by the Office to provide itself with primary standards of reference meeting the highest scientific requirements.

STANDARDS OF ELECTRO-MOTIVE FORCE.

The unit of electro-motive force, the volt, is legally defined as $\frac{1000}{1434}$ of the electro-motive force of a Clark Standard cell at 15° C.

The official standards of electro-motive force for a government should obviously be, as far as possible, independent of any error due to impurities of the chemicals used. A large number of cells were set up with the purest commercially obtainable materials, from a number of independent sources. The work of purifying these materials by special methods was begun. Cells have also been set up with some of the purified materials, though much still remains to be done.

The intercomparisons so far made indicate a most satisfactory agreement of all the

cells on hand, well within $\pm\frac{1}{2000}\%$. The mean electro-motive force of the three dozen or more cells furnishes therefore a standard of reference which may be relied on within this limit. In addition to the Clark cells, a number of Cadmium cells, having considerable advantages over Clark cells, have been set up, but owing to lack of time no comparisons have as yet been made. New cells of both types are to be added from time to time, and intercompared with the old ones to determine whether any observable changes have taken place.

The relation which the E. M. F. of the Clark cell bears to that of the Cadmium cell will also be periodically determined, furnishing an additional check on the constancy of the standards of both types.

With an accurately calibrated potentiometer, and reliable standards of electromotive force the office is thus prepared to undertake the verification of direct current volt-meters and millivolt-meters.

MEASUREMENT OF ELECTRIC CURRENTS.

A grave mistake was made by the International Congress in concretely defining all three of the principal electrical units, the ohm, volt and ampere, which are necessarily connected by the fixed relation $C = \frac{E}{R}$. Hence only two of the definitions are independent, the chances being infinitesimal that the three definitions satisfy the relation between them on account of the relatively large errors in the absolute determinations on which they are based. Indeed, it already seems that the volt, as defined in terms of the Clark cell is in error by almost .1%.

Since the standards of resistance and electromotive force, as specified by the International Congress, are certainly reproducible within $\frac{1}{1000}\%$, the unit of current intensity, defined as the current which will flow through a conductor of unit resistance, there being unit difference of potential between its terminals, would be fixed within the same limits of error.

Instead, it is defined in terms of the electro-chemical equivalent of silver. The voltametric measurement of a current is limited by the size of the apparatus available and is besides impossible under ordinary circumstances with the above accuracy.

Lord Rayleigh is of the opinion that his determination of the electro-chemical equivalent of silver may be in error by as much as $\frac{1}{10}\%$.

Retaining for the present the legal definitions of the ohm and volt, currents may be consistently measured by the fall in potential or potentiometer method, in terms of the specified standards of reference.

It is proposed to base all direct current measurements on these principles. With suitable low resistance standards for the measurement of heavy currents and with the set of Clark cells already on hand, the Office is prepared to undertake the verification of direct current ammeters within the limits practically set by the current generating apparatus on hand.

To summarize, the Office is therefore practically equipped for the verification of following classes of apparatus, viz:

Resistance Standards.—Coil of the following denominations: 1, 2, 5, 10, 100, 1000, 10,000 ohms.

Low Resistance Standards for current measurements of the following denominations: 0.1, 0.01, 0.001 and 0.0001 ohms.

Resistance boxes.

Potentiometers.

Ratio coils.

Standards of Electro-motive Force.—Clark standard cells and other standard cells.

Direct Current Measuring Apparatus. Millivoltmeters and voltmeters up to 150 volts.

Ammeters up to 50 amperes.

For the verification of direct current measuring apparatus of even moderate

range, the present facilities of the Office are entirely inadequate, although now-a-days potential differences up to 20,000 volts and currents of 20,000 amperes are met with in actual practice.

Provision must also be made for the calibration of Wattmeters and Energy meters.

The verification of alternating current measuring apparatus requires further facilities, and in view of the ever increasing importance of alternating current systems, such facilities should be provided without delay.

The verification of Condensers and Self Induction Standards also merits attention.

Another question, practically related to electrical measurements, is the photometry of arc and incandescent lamps.

Preliminary steps have already been taken by the American Institute of Electrical Engineers, looking forward to the coöperation of the office in the official verification of incandescent lamps as secondary photometric standards to enable even the moderate consumer to procure reliable standards at a reasonable rate.

The measurement of high and low temperatures will also be taken up, a knowledge of the exact thermal conditions under which certain industrial operations are conducted being of the utmost practical consequence.

There are two most reliable electrical methods based respectively on the variations of electrical resistance and of thermo-electromotive force with the temperature. Hence, with standards of electromotive force and resistance available, this subject is brought within easy reach.

No claim of originality is made in what has been accomplished. The magnificent work of the Physico-technical Reichsanstalt at Berlin with its staff of scientific and technical assistants and in its almost unlimited resources has been of the greatest help. It has set such a high standard of excellence that it will require years for similar bureaus, which will surely be organized by other governments, to attain.

Frank A. Wolff, Jr.

U. S. Office of Standard Weights and Measures.

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*THE ESTABLISHMENT OF A NATIONAL UNIVERSITY**.

The sub-committee appointed November 3, 1899, beg leave to submit the following report:

The resolution of reference to the sub-committee was as follows:

"That a sub-committee be requested to prepare for consideration by the full committee a detailed plan by which students who have taken a baccalaureate degree, or who have had an equivalent training, may have full and systematic advantage of the opportunities for advanced instruction and research which are now or may hereafter be offered by the Government; such a plan to include the coöperation with the Smithsonian Institution of the universities willing to accept a share of the responsibility incident thereto.

"It is understood that the financial administration of this plan should be such that whether or not Government aid be given, there shall be no discouragement of private gifts or bequests.

"It is understood that the scope of this plan should be indicated by the governmental collections and establishments which are now available, or as they may hereafter be increased or developed by the Government for its own purposes."

The undersigned members of the sub-committee have been in active correspondence and conference on the matters referred to them. They have made several visits to Washington, and have had the advantage of hearing the views of representative Regents of the Smithsonian Institution and those of the directors of the scientific bureaus of the Government. In particular, they have profited by consultations with representatives of the American Association of Agricultural Colleges and

* Report of the sub-committee appointed November 3, 1899, to the Committee of the National Educational Association, appointed July 7, 1898, to investigate the entire subject of the establishment of a National University.

Experiment Stations, which body has had before it for some time past a project for the utilization, for graduate students, of the resources of the Departments at Washington.

The sub-committee are of opinion that the general plan of action now under discussion by this committee has secured, and will command, the active support of the directors and administrators of the Government's scientific work as well as that of the educational institutions of the country. It is very generally accepted as the best possible way of meeting what is reasonable in the demand for the establishment of a national university. The success of the plan, however, will depend upon the wisdom with which its details are first formulated and then administered.

Fortunately, the Congress of the United States has already declared it to be the policy of the Government to encourage the use of the scientific collections at Washington by properly qualified students, for purposes of research. This was done by Joint Resolution, April 12, 1892, which reads as follows:

Joint resolution to encourage the establishment and endowment of institutions of learning at the national capital by defining the policy of the Government with reference to the use of its literary and scientific collections by students:

Whereas, large collections illustrative of the various arts and science and facilitating literary and scientific research have been accumulated by the action of Congress through a series of years at the national capital; and

Whereas, it was the original purpose of the Government thereby to promote research and the diffusion of knowledge, and is now the settled policy and present practice of those charged with the care of these collections specially to encourage students who devote their time to the investigation and study of any branch of knowledge by allowing to them all proper use thereof; and

Whereas, it is represented that the enumeration of these facilities and the formal statement of this policy will encourage the establishment and endowment of institutions of learning at the seat of Government, and promote the work of education by attracting students to avail themselves of the advantages aforesaid under the direction of competent instructors: Therefore,

Resolved by the Senate and House of Representatives of the United States of America, in Congress assembled, That the facilities for research and illustration in the following and any other Governmental collections now existing or hereafter to be established in the city of Washington for the promotion of knowledge shall be accessible, under such rules and restrictions as the officers in charge of each collection may prescribe, subject to such authority as is now or may hereafter be permitted by law, to the scientific investigators and to students of any institution of higher education now incorporated or hereafter to be incorporated under the laws of Congress or of the District of Columbia, to wit:

One. Of the Library of Congress.
Two. Of the National Museum.
Three. Of the Patent Office.
Four. Of the Bureau of Education.
Five. Of the Bureau of Ethnology.
Six. Of the Army Medical Museum.
Seven. Of the Department of Agriculture.
Eight. Of the Fish Commission.
Nine. Of the Botanic Gardens.
Ten. Of the Coast and Geodetic Survey.
Eleven. Of the Geological Survey.
Twelve. Of the Naval Observatory.
Approved, April 12, 1892.

The express purpose of this joint resolution is to encourage the foundation of institutions at Washington which may take advantage of the collections and facilities enumerated. This resolution affirms and establishes the principle which must underlie any such plan for a School or Bureau of Research as this Committee now has before it.

The governmental collections and establishments having been declared available for research, the next question is as to the systematic organization of the work to be carried on and the proper oversight of the persons engaged in making investigations. At this point certain practical difficulties must be met.

These collections and establishments are under widely different jurisdictions. Some

of them are attached to the Executive Departments, others are independent of any control but that of the Congress. Some of them are adequately equipped and well housed, others are most inadequately provided for. To wait for the reorganization of the scientific work of the Government in systematic fashion, is to postpone indefinitely the question of taking advantage of the opportunites which the Government has to offer. In the view of your sub-committee therefore, it is essential, in any plan which may now be adopted, that no attempt be made to alter the existing status of the Government's scientific work; that is a large undertaking, for which time and further experience are necessary. The conditions at Washington must be accepted just as they are. The head of each Bureau or Division which can offer any facilities for research, should be asked to state, in detail, just what those facilities are, how many persons can be received, and under what limitations or conditions. It would be one of the functions of any administrative officer who might be charged with the oversight of a School or Bureau of Research, to make these facilities known, as well as to exercise supervision over the students who avail themselves of them.

The resolution of reference contemplates the active coöperation of the Smithsonian Institution in the conduct of the proposed School or Bureau. The attitude of the governing board of the Smithsonian towards the undertaking, becomes then a matter of great importance. What this attitude is we are able to learn from the action taken by the Regents of the Smithsonian Institution at their annual meeting, held January 24, 1900, upon a communication from the American Association of Agricultural Colleges and Experiment Stations, which asked for the organization of a Bureau of Graduate Study in Washington under the supervision of the Smithsonian. The report of the committee to which the communication had been referred, contained this language:

"The committee does not hesitate to express its warm and decided sympathy with the general purpose of the movement thus made by the associated colleges. The object sought commends itself to us all, and the zeal and ability with which it has been pressed upon our consideration by the very able and distinguished educators and scientists connected with these colleges furnish ample assurance that the consummation of the great and leading object sought by them is only a question of time. The material already collected in the bureaus and departments of the government furnishes a rich mine of educational wealth that will not be permitted to remain forever undeveloped. This material is now being constantly enriched by the most valuable additions to its present enormous wealth. Already it has invited to the national capital many distinguished scientists, anxious to avail themselves of the superior advantages thus offered for investigation and research.

"Your committee, however, is painfully impressed with the fact that the powers of the Smithsonian Institution as at present organized are scarcely broad enough to embrace the work proposed. And the committee is equally impressed with the fact that even with enlarged authority its present financial condition would absolutely prevent anything like efficient and creditable performance of the work contemplated.

"It is well known to the members of this board that a great wealth of material—material which would be of immense utility in the successful accomplishment of the purposes indicated by the associated colleges—lies buried in the crypts and cellars of the National Museum.

"If our institution is unable for want of room, as it undoubtedly is, even to place this valuable material on exhibition for the public eyes, and as little to arrange it for scientific uses, the problem of providing halls for lectures and meeting the necessary expenditures incident to the work proposed becomes serious and formidable in the extreme. Your committee is not prepared to make definite recommendations to the board for its final or ultimate action. That which is clearly inexpedient to-day may become not only expedient but eminently desirable to-morrow."

It is felt by the Regents of the Smithsonian Institution that their present powers are hardly broad enough to embrace educational work, and also that it is doubtful whether the Congress has power, under the Constitution, to appropriate money, raised by taxation, for purposes of education. In

view of the past construction of the 'general welfare' clause of the Constitution, and in view of the fact that the Smithsonian Institution was established 'for the increase and diffusion of knowledge among men,' your sub-committee are unable to share these doubts.

At the same meeting of the Regents of the Smithsonian Institution to which reference has been made, Mr. Alexander Graham Bell introduced the following resolution, which is to be the subject of consideration at a later meeting:

"In order to facilitate the utilization of the government departments for the purposes of research, in pursuance of the policy enunciated by Congress, in a Joint Resolution approved April 12, 1892:

Resolved, That Congress be asked to provide for an Assistant Secretary of the Smithsonian Institution in charge of Research in the Government Departments, whose duty it shall be to ascertain and make known what facilities for Research exist in the Government Departments, and arrange with the heads of departments, and with the officers in charge of Government Collections, rules and regulations under which suitably qualified persons may have access to the Government collections for the purposes of Research, with due regard to the needs and requirements of the work of the Government; and it shall also be his duty to direct the researches of such persons into lines which will promote the interests of the government, and the development of the natural resources, agriculture, manufactures, and commerce of the country, and (generally) promote the progress of science and the useful arts, and the increase and diffusion of knowledge among men."

Should the Regents decide to adopt this resolution, and should the Congress act favorably upon the request which it contains, a Bureau of Research would be established competent to do the work which this committee have in mind.

In this way all of the ends which this committee has deemed desirable, would be accomplished—save one. That one your sub-committee believe to be of the highest importance. It is the co-operation of the universities and colleges of the country in carrying on such systematic research work as is contemplated. That such co-operation should be provided for, by the constitution of an advisory board or in some other way, your sub-commtttee deem essential, not only in the interest of the work itself, but also in that of the universities and colleges. That they would be greatly benefited by the new stimulus which would come from united effort in assisting to conduct such research work as is proposed, is certain.

An alternative plan is worthy of careful consideration. This is to make the Bureau of Education, instead of the Smithsonian Institution, the administrative center of the Bureau of Research. To accomplish this would involve, perhaps, the long-desired erection of the Bureau of Education into a separate department, on a plane with the Department of Labor, and the provision of an appropriate salary for the Commissioner instead of the pittance of $3000 now allowed. The executive head of the Bureau of Research might then be an assistant Commissioner of Education at a salary of $4000 or $4500. One marked advantage of this plan is that the intellectual outlook of the Bureau of Education is likely to be broader than that of the Smithsonian Institution, as the Bureau is in close touch and active correspondence with all the educational institutions of the country, and not merely with those whose main or sole interest is in the field of the natural sciences.

If it is decided that the initiative in this undertaking shall lie with the Regents of the Smithsonian Institution, then your subcommittee are prepared to recommend the following course of action:

1. That the Regents of the Smithsonian Institution be requested to ask the Congress of the United States for a special appropriation for the work of research and investigation, to be conducted under their supervision by persons properly qualified therefor. Such work to be so conducted as to utilize the libraries, scientific collections, apparatus and laboratories owned

by the United States and in charge of officers of the United States, for investigations and researches, under regulations to be prescribed by the said Regents, and as far as shall be mutually agreed upon between the said Regents and the heads of the several executive departments of the Government, the Librarian of Congress, Commissioner of Labor, Commissioner of Fish and Fisheries, and the Secretary of the Smithsonian Institution, with a view of carrying out the policy of Congress, declared in the Joint Resolution of April 12, 1892.

2. That the Regents be requested to ask the general public for gifts of money, to be used in providing buildings, laboratories, equipment and endowments, for purposes of instruction, such instruction to be limited to students who are graduates of properly accredited institutions, or those who are otherwise properly qualified, it being understood that it shall not be the purpose of the Smithsonian Institution to confer degrees of any kind in connection with such instruction.

3. That the Regents be requested to formulate a plan for the appointment of an Advisory Board; the members of said Board to represent the leading educational institutions of the country, with a view to securing the active co-operation of the colleges and universities of the country in carrying on this undertaking.

If, however, it is decided that the Bureau of Education is the best administrative center for this work, then we recommend the following course of action:

1. That the Congress be requested to erect the Bureau of Education into an independent department, on a plane with the Department of Labor, and to provide a salary of not less than $5000 for the Commissioner of Education.

2. That the Congress be requested to provide for an Assistant Commissioner of Education, at a salary of not less than $4000, whose duty it shall be to ascertain and make known what facilities for research exist in the government departments and collections at Washington; to formulate, in connection with the heads of the several departments and the officers in charge of Government collections, rules and regulations under which suitably qualified persons may undertake research in those departments and collections, with a view to carrying out the policy of Congress as declared in the joint resolution approved April 12, 1892; and to exercise general supervision over the persons permitted to undertake such research.

3. That the Department of Education, so organized, be requested to formulate a plan for the appointment of an advisory board, representing the colleges and universities of the country which receive aid from the government or which have not fewer than 25 resident graduate students in any one year, with a view to securing the active co-operation of such colleges and universities in organizing and maintaining the work of research at Washington.

4. That in accordance with a plan to be prepared and adopted by the Department of Education, in consultation with such advisory board or its executive committee, the colleges and universities of the country be asked to give credit, toward the requirements for their higher degrees, for research carried on at Washington under the supervision of the Department of Education.

Under the terms of either of the plans proposed it is assumed that the persons admitted to carry on research will be graduates of a college or university in good standing, or will have had an equivalent training.

Such a bureau of research, whether it be placed under the care of the Smithsonian Institution or under that of the Department of Education—which would supersede the existing Bureau of Education—would be a source of strength to the higher education of the United States and a great advantage to the Government in its work of promoting the progress of science and the useful arts, and in applying the result of scientific investigation to the development of the natural resources of the country, of agriculture, of manufactures, and of commerce.

We regret that our colleague, Dr. J. L. M. Curry, has, through absence from home, been prevented from sharing in the formulation of this report.

Respectfully submitted,

William R. Harper,
Nicholas Murray Butler.

Chicago, Ill.,
Feb. 26, 1900.

ASSOCIATION OF AMERICAN ANATOMISTS.

The Association held its twelfth session December 27 and 28, 1899, at New Haven, Connecticut, in conjunction with the affiliated societies. There were present nine-

teen members:—Blake, Ferris, Gerrish, Herrick, Holmes, Hrdlicka, Huber, Lamb, Mackenzie, Mall, Mellus, Miller, M. B. Moody, R. O. Moody, Minot, Piersol, Tuttle, Shepherd, and Wilder. New members were elected as follows:—R. Tait Mackenzie, B.A., M.D., Demonstrator of Anatomy, McGill University, Montreal, Canada, No. 59 Metcalfe St., Montreal; E. Linden Mellus, M.D., Fellow in Anatomy, Johns Hopkins University, Baltimore, Md., No. 10 East Chase Street, Baltimore; Wm. S. Miller, M.D., Assistant Professor of Vertebrate Anatomy, Wisconsin University, Madison, Wisconsin, 615 Lake Street, Madison; Alexander Primrose, M.B.C.M. (Edin.), M.R.C.S. (Eng.), Professor of Anatomy, University of Toronto, Canada, 100 College Street, Toronto; Richard Dresser Small, A.B, M.D., Instructor in Anatomy, Portland School for Medical Instruction, 606 Congress Street, Portland, Maine. Dr. John Cleland of Glasgow, Scotland, was elected an honorary member. Dr. Frank Baker resigned from the Committee on Anatomical Nomenclature and Dr. H. B. Ferris was appointed to fill the vacancy. The annual dues were increased to five dollars. It was decided to meet as usual with the Congress of American Physicians and Surgeons this spring. The Association voted that members desiring to subscribe for the *Journal of Anatomy and Physiology* could do so through its Secretary at net cost of $5.30; also that the titles of papers to be read at meetings should be accompanied by abstracts of about 150 words each. Officers for the ensuing term were elected:—Dr. George S. Huntington, New York City, President; Dr. F. H. Gerrish, Portland, Me., First Vice-President; Dr. G. C. Huber, University of Michigan, Second Vice-President; Dr. D. S. Lamb, Washington, Secretary and Treasurer; Dr. C. S. Minot, of Boston, member of the Executive Committee in place of Dr. Gerrish, retired.

In the absence of Drs. Huntington and Spitzka, the Committee on Anatomical Nomenclature (Drs. Gerrish, Wilder and Ferris) reported progress and asked the Association to consider, with a view to decisive action at the next session, the following names for constituents of the peripheral nervous system. Where a single term is given it is the one adopted by the B. N. A., and also preferred unanimously by the Committee. Where two terms are used the first is the one in the B. N. A., but this does not imply that it is preferred by the Committee.

Nervi cerebrales vel craniales.

Nervi olfactorii,
Nervus opticus,
" oculomotorius,
" trochlearis,
" trigeminus *vel* trifacialis,
Nervus ophthalmicus,
" maxillaris,
" mandibularis,
Nervus abducens,
" facialis,
" acusticus *vel* auditorius,
" glossopharyngeus,
" vagus,
" accessorius,
" hypoglossus.

Nervi spinales.

Nervi cervicales,
Plexus brachialis,
Nervus musculocutaneus,
" medianus,
" ulnaris,
" radialis.
Nervi thoracales,
" lumbales,
" sacrales,
Nervus coccygeus,
Plexus lumbalis,
" sacralis,
Nervus iliohypogastricus,
" ilioïnguinalis,
" genitofemoralis (genitocruralis),
" obturatorius,
" femoralis (cruralis anterior),
" ischiadicus *vel* sciaticus.

Systema nervorum sympathicum.

Truncus sympathicus,
Ganglia trunci sympathici,
Plexus sympathici,
Ganglia plexuum sympathicorum.

The address of the President, Dr. Wilder, was entitled, 'Historic, ethical and practical considerations respecting the names and numbers of the definitive encephalic segments.' There were presented facts and arguments in favor of maintaining the customary method of enumerating the segments of the brain beginning with the most cephalic or 'anterior,' and in favor of retaining for five of these segments the names, *prosencephalon*, *diencephalon*, *mesencephalon*, *epencephalon* and *metencephalon*, which were adopted or proposed in 1867 by the editors of the seventh edition of 'Quain's Anatomy.' In particular it was shown that the replacement of *metencephalon* by 'myelencephalon' for the last (oblongatal) segment, as done by Huxley and in the B. N. A., is not only unjustifiable on historic and ethical grounds, but practically objectionable because it apparently involves the retention of the lengthy and unrelated terms of the B. N. A., viz: 'myelencephalon,' 'ventriculus quartus,' 'tela chorioidea ventriculi quarti,' 'plexus chorioideus ventriculi quarti,' and 'apertura medialis ventriculi quarti' (foramen Magendii), and the abandonment of the series of correlated single-word terms, *metencephalon*, *metacoelia*, *metatela*, *metaplexus* and *metaporus*. (The address will be published in SCIENCE.)

The following papers were read:

Divisions of cranial bones in man and animals: DR. ALES HRDLICKA, of New York City.

Five classes of divisions are described and demonstrated, namely: (1) results of fractures; (2) normal, partial divisions in definite locations in the bones of the embryos and new-born; (3) anomalous partial divisions consequent upon the formation of a foramen in the ossifying bone; (4) divisions due to a retardation of the union of any of the normal segments of the bones; and (5) anomalous divisions due to an abnormal multiplicity of the centers of ossification. Class (2):—Two of the most prominent and constant of such divisions in man are the parietal incisure of Broca, and a squamous suture situated near the middle of the occipital border of the parietal bone (termed 'parietal suture' by the author). Class (3):—Rare in man, so far as the bones of the cranial vault are concerned, but are common in the human superior maxillæ in connection with the infraorbital foramen; they are very frequent in the parietal and temporal bones in mammals, particularly in the herbivora. Class (5):—Occur generally in the form of sutures dividing the whole bone or separating one of its angles. They are liable to be confounded with the previous and are somewhat allied to the same. These divisions are well known in the human parietal; the author has the records of eighteen new cases, found principally in macaques; one of the specimens presented before the Association shows a bilateral division of the parietal bone in a chimpanzee. In lower mammals these divisions are extremely rare.

A further contribution to the study of the tibia, relative to its shapes (vide last year's Proceedings of the Association): DR. ALES HRDLICKA.

An effort has been made during 1899 to learn the occupations of the subjects whose tibias had been examined. The returns show a great diversity of occupations and even of classes of occupations, and it is plain that if any definite conclusions are to be reached, the investigations must extend over at least another thousand of subjects. The main indications so far are as follows: Inactivity of the lower extremities favors the persistence of the adolescent shape of the tibiæ; considerable activity in the lower limbs especially if of a definite kind, favors a differentiation in the shape of the bones. In the American Indians who were always

great walkers and did otherwise comparatively but little, types two and four of tibiæ prevail. In strong, but also in rachitic, individuals there is an inclination to type 3 of the bones. There was but little occasion to inquire into the influence of heredity on the shape of the tibiæ, nevertheless such influence seems very probable.

The deep fascia: DR. HOLMES, University of Pennsylvania.

The deep fascia is a firm tense membrane of wide extent and complex function. It lines the interior of the abdomen, protects the various orifices, forms ligaments for the organs and a floor for the pelvis, sheathes vessels and muscles and binds muscles into groups, divides regions into spaces and sets off organs by themselves, so that differentiation into fascial compartments means also differentiation into function. The transversalis fascia is a continuation of the fascia-lata and forms a fibrous bag for the abdomen continuous posteriorly with the lumbar fascia. It is the real pelvic floor rather than the levator ani muscle. The subdivisions of the muscles of the thigh, leg and foot, and of the axilla, arm, forearm and hand indicate the separate office of each group. In the cervical region the three divisions of investing, pretracheal, and prevertebral, indicate similar conditions; the prevertebral layer being of especial value in conserving the action of the esophagus, larynx and trachea. The especial object of the paper is to direct the attention of the members of the Association to the greater importance of the fascia, and also to maintain that whenever we find its distribution separating the structures, we may regard it as an indication of an equal separation into a distinct function.

The facial expression of fatigue and violent effort: DR. R. TAIT MCKENZIE, McGill University.

In fatigue, as observed in a foot-race of a mile, we see the following changes: The lips are slightly parted, the teeth open, eyes semi-closed, brows contracted, as in mental concentration, the upper half of the orbicularis acting with the corrugator supercilii. As the race proceeds, the lips are drawn down by the depressors and up by the levator proprius and zygomaticus minor. The corrugator acts strongly. As the respiratory need increases, the nostrils are dilated by the levator labii superioris alæque nasi, accentuating the expression of grief. This expression then passes away and the face becomes apathetic, the mouth gapes and the jaw drops, the upper eyelid tends to droop. The lowering of the upper lid is counteracted either by throwing the head back, or by bringing into action the occipito-frontalis. This give rise to an expression of astonishment in the upper part of the face. In extreme exhaustion or collapse, the jaw drops, the upper lid comes down, the face becomes expressionless. When a violent effort is made the expression comes more nearly to correspond to rage.

A note on the relation of the external carotid artery: DR. WM. KEILLER, of Texas.

Text-book descriptions of the relation of the external carotid (with the exception of Cunningham's description in his 'Dissector's Guide') are incorrect: (1) In describing the ramus of the jaw as an internal relation when it is really external. (2) The structures described in text-books as lying in front are really external. (3) The statements as to its relations to the parotid gland are misleading. (4) It is at first anterior, and slightly internal to the internal carotid, then winds backwards and outwards till it lies on its outer side. (5) Most of the structures described as lying behind it are internal.

How best to teach anatomy to the third year medical students: DR. KEILLER.

Brief sketch of a course of dissections of

direct surgical and medical interest, and leading up to an operative course, being the third year's course of practical anatomy at the University of Texas.

The anatomy of the anal region : Dr. Keiller.

Careful description of the relations of the levator ani, external and internal sphincter, the radicles of the hemorrhoidal veins, and the bearing of these facts on operations for piles and on the pathology of ischiorectal abscess.

On a hitherto unrecognized form of vertebrate blood circulation in organs without capillaries: Dr. Minot, Boston.

Non-development of the left heart and closure of the aortic valve, depending upon an error in the development of the auricular septum : Dr. Blake, New York City.

The child from which the specimen was taken lived four days. It presented no other abnormalities. It was cyanotic and died of cardiac failure. The right chambers of heart, the pulmonary artery and ductus arteriosus are very large. The left chambers are very small. The aortic opening is closed by a fibrous septum consisting of the fused valves. The ascending aorta is only of sufficient caliber to supply the coronary arteries. The eustachian valve is rudimentary.

The valve of the foramen ovale is developed in the right auricle so that fluids can only pass from the left to the right auricle. This arrangement of the valve can be explained by the method of development of the auricular septum, as described by Born in rabbit embryos, if we presume an overgrowth of the septum secundum and an insufficient development of the primary septum. The interest of the specimen lies in the generalization of the application of Born's theory of development. The left ventricle receiving no blood, the aortic valves were kept closed by back pressure and fused. No similar anomalies could be found recorded.

The delimitation of the divisions of the large intestine according to intrinsic features : Dr. Gerrish.

The argument made is that the segment variously called sigmoid colon, sigmoid flexure, iliac colon, and omega flexure, should include all of that part and only that part of the large intestine, caudad of the crest of the ilium, which has a mesentery. This plan would subtract a little from the cephalic portion of the sigmoid colon, as generally accepted now, and would add to its caudal portion making the rectum begin at the third sacral vertebra.

The normal capacity of the human bladder : Dr. Gerrish.

This question can be answered by physiologic tests only. The normal capacity is not shown by the amount of fluid which the viscus can possibly contain without rupture or even by that which it occasionally holds without appreciable harm. But it can be determined by ascertaining the average amount of urine secreted in 24 hours and the average number of micturitions in the same time. By this method the capacity is found to be not much in excess of 250 grams (8 oz.) : one-half that usually stated.

Observations on sensory nerve fibers in the visceral nerves, with remarks on their mode of termination : Dr. Huber.

That relatively large medullated nerves end in the viscera we know from the observations of Gaskell, Langley and Edgeworth, and from the more recent investigations of numerous observers who have investigated the sympathetic nervous system or the innervation of the viscera with the aid of the Golgi or methylin blue methods. That these relatively large medullated nerves terminate either in special end-organs, Pacinian corpuscles, encapsulated nerve-endings of Timofew, etc., or in free sensory endings, seems also well established. The

writer proposes to draw attention more especially to the free sensory endings in viscera, and to emphasize the following points: (1) the repeated division of such sensory nerves before losing their medullary sheaths; (2) the relatively large number of arborizations in which such nerves terminate; and (3) the fact that they terminate in the mucosa and epithelium lining the hollow organs and ducts.

Sensory nerve terminations in the tendons of the extrinsic eye muscles of the cat: DR. HUBER.

Marchi, Ciaccio and Sherrington have shown that medullated nerve fibers terminate in the tendons of the extrinsic eye muscles of a number of mammals. These nerves are looked upon as sensory nerves, although, as Sherrington has shown, not branches of the ophthalmic division of the trigeminus. In the cat the nerves ending in the tendons of the extrinsic eye muscles do so in terminations which differ in structure from the neuro-tendinous endings found in other skeletal muscles of this animal. The medullary nerves which terminate in the eye muscles of the cat lose their medullary sheaths just before reaching their destination and end in a network of varicose fibers, which network surrounds the tendon fasciculi just distal to the insertion of the muscle fibers. Each tendon fasciculus surrounded by such a plexus is enclosed within a thin, closely fitting, fibrous sheath.

Comments upon the figure of the mesal (median) aspect of a human brain as published by His and reproduced by him and others: DR. WILDER.

"In the *Archiv für Anatomie* for 1893, Professor His published a figure of the mesal aspect of an adult human brain; it was reproduced on p. 76 of the protocols of the B. N. A., and in the B. N. A. itself, *Archiv für Anat.*, 1895, Suppl. Band., p. 161, but is there stated (evidently through inadvertence) to represent a fetal brain of the third month. The figure has been reproduced without comment by Van Gehuchten (second edition) and Barker ('The Nervous System,' 1899, Fig. 92). Even if designed merely as a diagram in illustration of its author's views of the definitive segments, and even if many teachers and investigators are so well informed as not to be misled by its errors of omission and commission, certain features are certain to cause serious and wide-spread misapprehension. Twenty such features were specified. The most important exemplify the general defect of such figures in most manuals, viz., incomplete circumscription of the cavities, and inadequate demarcation of the cut surfaces from the natural (pial or endymal). In these respects anatomists may well imitate the accuracy of Reichert ('Der Bau des menschlichen Gehirns,' 1859–61), although his figures are not absolutely perfect.

If an 'Isthmus Rhombencephali' why not an 'Isthmus Prosencephali'? DR. STROUD, Cornell University.

"In the early fetal brain of man, the cat, and perhaps some other mammals, there is a necklike region just caudad of the mesencephal. Professor Wilhelm His names this region 'Isthmus Rhombencephali,' and apparently regards it as coördinate with the other five definitive segments recognized by him (*Archiv. für Anatomie*, 1893, 173–174; 1895, Suppl. Bd. 'B. N. A.,' 157). But in these same specimens, and in many of the figures published by His in the *Archiv* for 1892 and 1893, and in 'Die Entwickelung des menschlichen Rautenhirns,' 1891, there is another necklike region cephalad of the mesencephal quite as distinct and sometimes more so. A schema of encephalic segmentation should be consistent, and while not denying the possibility that one or both of these regions may represent a primitive neuromere, it seems reasonable to conclude that, taking into account the

adult and developmental conditions in vertebrates generally, probably neither should be regarded as a definitive segment.

The basis and nature of a schema of the definitive encephalic segments: Dr. Wilder.

"A satisfactory definition of 'Definitive Encephalic Segment' has not yet been framed, but the best example is the Mesencephalon (crura and quadrigeminum). Although developed from one 'vesicle,' this apparently includes at least two of the 'neuromeres or primitive segments.' Many points are still undetermined. Some were discussed in 1897 in 'What is the Morphologic Status of the Olfactory Portion of the Brain?' Others are indicated among the fifty 'Questions as to the Segmental Constitution of the Brain'; copies of the seven mimeographed sheets bearing these 'questions' were distributed at the meeting and will be sent to those interested. The following conclusions are regarded as sound:—The provisional schema of the definitive segments should be based upon adult rather than developmental conditions. The definitive segments need not be structurally or developmentally identical. They need not coincide with either, (*a*) the primitive neuromeres, or (*b*) the primary encephalic vesicles, (*c*) the secondary vesicles. No species or group should be ignored. The presumption is in favor of generalized forms, and not in favor of forms merely because they are available for other purposes. When both naturalness and convenience are taken into account, the best provisional schema corresponds mainly with the one indicated in the table on p. 29 of the Proceedings of this Association for May, 1897."

Is neuron available as a designation of the central nervous system? Dr. Wilder.

"Neuron (from τό νεῦρον) was proposed by me in this sense in 1884 (*N. Y. Med. Jour.*, Aug. 2, p. 114), and employed in the same Journal, March 28, 1885, p. 356; in addresses before the Amer. Neurol. Assoc.; (*Jour. Nerv. and Ment. Dis.*, July, 1885); *Amer. Asso. Adv. Sci. Proceedings*, 1885, and in the second edition of 'Anatomical Technology,' 1886. It has been adopted by McClure, Minot, Waters and others. The reasons for its abandonment in 1889 for *neuraxis*, as stated in the Proceedings of this Association for 1895, p. 44, and Ref. Handbook of Med. Sci., IX., 100, now seem to me inadequate. *Neuron* is the basis of *neural* (as applied to aspect, folds, furrow, and canal) and of *neurenteric* and other compounds, and it is the natural correlative of *enteron* (entire alimentary canal) and of *axon* (notochord or primitive skeletal axis). Not until 1891 did Waldeyer propose *neuron* for the nerve-cell and its processes; not until 1893 did Shafer apply it to the axis-cylinder process. As with *tarsus* and *cilium* the context would commonly avert confusion between the macroscopic and microscopic significations of the word in a given case. The compounds *macroneuron* and *microneuron* might be employed if necessary, or (as suggested by Barker, p. 40), the histologic element might be designated by *neurōne*, as if from νευρών. Note.—The question is now further complicated by Van Gehuchten's adoption of 'Neuraxe' as the title of a new journal of neurology.

Polydactylism and Syndactylism: Dr. Shepherd, of Montreal.

Dr. Shepherd showed a series of skiagrams and photographs illustrating some of the deformities of the digits which he had met with. The first case was that of a young man aged 21, who had six digits on each foot and hand, and they were so arranged that the deformity would not be noticed unless attention was especially attracted to there was a gradual diminution in the size from the middle finger to the supernumer-

ary little digit (post minimus). His paternal greatgrandfather had supernumerary digits, as had a paternal uncle, and this uncle's children had supernumerary digits. Two of his own brothers and two of his sisters had a like conditions as well as his sisters' and brothers' children. In another case also there was a hereditary history for some generations on the father's side. Another case was stated and the photographs shown where, in a man aged 22, there was no thumb on the left hand and only a very rudimentary one on the right hand; no history of heredity. Another, where there was absence of the thumb of right hand and a rudimentary little finger with absence of the fifth metacarpal bone. The father had a similar deformity. A remarkable skiagram was exhibited which showed a fusion anteriorly of the proximal phalanges of the middle and ring fingers, and a complete fusion of the middle and distal phalanges of these fingers; also a case of fusion of the ring and middle fingers of the right hand in a boy age 20. In neither case was there any history of heredity. In the case of polydactylism, Dr. Shepherd thought some of the cases might be due to reversion, but the majority he thought were probably the result of dichotomy.

D. S. LAMB,
Secretary.

SCIENTIFIC BOOKS.

Kongl. Svenska Vetenskaps-Akadamiens Handlingar, Bandet 31. No. 5. Rhopalocera Æthiopica. Die Tagfalter des Æthiopischen Faunengebietes. Eine Systematisch-Geographische Studie. CHR. AURIVILLIUS. Pp. 571. Six chromo-lithographic plates containing 50 figures. Numerous figures in the text. Large 4to. Stockholm, 1898.

Without the aid which learned societies are sometimes able to supply, important works, like the Rhopalocera Æthiopica of Professor Aurivillius, would not often see the light. The demand for such treatises is restricted, being largely confined to specialists, and the expense of producing them is necessarily very great. For many years the learned author has been gathering the material for his undertaking, which having been completed, was laid before the Royal Academy of Sciences in Stockholm on the 10th of June, 1898. The work was issued from the press in June of 1899.

After a brief introduction the author defines the limits and subdivisions of the Ethiopian Region, closely following Wallace, Sclater and others, and excluding the regions immediately bordering upon the Mediterranean from consideration, because the fauna of the northern coast-lands is distinctly palæarctic, and including southern Arabia, the tropical islands, and Madagascar.

This chapter is followed by a bibliography of the subject, arranged according to the political subdivisions of the region. The list of books and papers, while extensive, is, nevertheless, not as complete as might be desired, a number of titles having been apparently overlooked in preparing the bibliography, although in most cases they are subsequently referred to in the text.

The systematic position of the Rhopalocera is next discussed. The author follows Haase and E. Reuter in excluding the Hesperiidæ from the Rhopalocera, regarding them as an independent group, the *Grypocera*, of equal value with the butterflies, and intermediate between them and the moths, or Heterocera. In this view, he will probably find few followers, although a good deal may be said in favor of such a procedure. The Hesperiidæ are accordingly excluded from consideration in the treatise, which enumerates sixteen hundred and thirteen species of Rhopalocera, in this restricted sense, as occurring in the Ethiopian region. Of these species thirty-three, or 2.04 per centum of the whole, also occur in other faunal regions. If we include the Hesperiidæ enumerated by the present writer in his 'Synonymic Catalogue of the Hesperiidæ of Africa and the Adjacent Islands,' published in the Proceedings of the Zoological Society of London in 1896, to which some twenty or more species, described since then must be added, we have a total of nineteen hundred and eighty, or, in

round numbers, two thousand species of Rhopalocera in the usually accepted sense of the term occurring in the Ethiopian region. Further explorations are likely to bring to light many species as yet unknown, and the student who is familiar with the subject will see that this is from the standpoint of the lepidopterist one of the richest regions on the globe, the number of species greatly exceeding that represented by the butterfly-faunæ of the Palæarctic and Nearctic regions combined. In extra-tropical North America there occur about six hundred and fifty species, and in Europe and extra-tropical Asia together not more than seven hundred species all told.

A chapter is devoted to terminology. The author's views as to what properly constitutes a generic name are clear, logical, and forcibly expressed. He rejects as *nomina nuda* the generic terms employed in Hübner's 'Tentamen,' Billberg's 'Enumeratio,' and other "equally worthless publications, which have been regarded as establishing priority for a name, although these names are unaccompanied by any description of the genus, and are only applied to one, or at most several species."

The bulk of the work, four hundred and sixty-three pages, is taken up in presenting a Synonymic Catalogue of the species, keys to the various families, subfamilies, and genera being provided. This portion of the work cannot fail to be exceedingly useful to the student, and may in general be said to be very well done. Here and there errors are discoverable, owing to the fact that the author did not have access to the types of some of the species which he enumerates. It is not, however, the purpose of the writer in the present brief review to point out these occasional blemishes, as attention would be more properly called to them in a journal specifically devoted to entomology.

The concluding portion of the text, pp. 493–537, is devoted to a discussion of facts relating to the distribution of species in the various zoögeographical subregions of the Ethiopian territory, and the relationship of the butterfly-fauna of Africa to the lepidoptera of other portions of the earth, followed by some observations upon seasonal dimorphism and protective mimicry. This is to the general student the most interesting part of the entire treatise, and brings into light some highly interesting facts.

The Ethiopian butterfly-fauna includes one hundred and twenty-eight genera, of which eighty-six, or nearly 68 per cent. are peculiar to this region. Of the forty-two genera, which occur in the other regions of the earth, eight, *Danais*, *Pyrameis*, *Libythea*, *Cupido*, *Heodes* (*Chrysophanus*, *Auctorem*), *Pieris*, *Colias*, and *Papilio* are more or less cosmopolitan, while *Acraea* (sens. lat.), *Catopsilia* (sens. lat.), and *Terias* are common to the tropics and sub-tropics of both hemispheres. Of the remaining thirty-one genera which the Ethiopian region possesses in common with other regions, twenty occur in the Indo-malayan, and to some extent also in the Austro-malayan Regions, but are altogether wanting in the Palæacrtic region. These genera are *Euplœa*, *Elymnias*, *Melanitis*, *Henotesia*, *Atella*, *Salamis*, *Hypolimnas*, *Kallima*, *Eurytela*, *Ergolis*, *Biblia*, *Cyrestis*, *Abisara*, *Deudorix*, *Hypolycæna*, *Spalgis*, *Lycænesthes*, *Leptosia*, *Appias*, and *Eronia*. The genera *Yphthima*, *Precis*, *Charaxes*, *Spindasis*, and *Teracolus* are Indo-malayan, although they are represented by one or other species in the extreme southern portion of the Palæarctic Region. *Argynnis* and *Neptis* are well represented in the Palæarctic and Indo-malayan Regions, *Pararge*, *Brenthis* and *Phyllocharis* are to be classed as Palæarctic genera, though they are represented in the northernmost portion of the Indo-malayan Region, and *Brenthis* is found in North America, and extends along the western Cordilleras to the extreme southern end of the continent of South America. The only remaining genus, *Hypanartia*, is peculiar to Africa and the tropical and subtropical regions of the Western Hemisphere.

Of the forty-two genera which Africa possesses in common with other regions, all except the three palæarctic genera and *Hypanartia* are found in the Indo-malayan region. Whether they migrated from Asia into Africa or from Africa into Asia cannot well be determined, but that, if such migration occurred, it must have been at a time when climatic and other conditions were widely different from what they now

are, is plain. A wide barrier of sea and arid lands devoid of suitable vegetation separates at the present time the regions in which these insects, for the most part forest-loving, occur. The sandy wastes of Arabia and the rocky plateaus of Abyssinia are a great and impassable barrier, to say nothing of the Indian Ocean, to the transfer of genera which frequent the hot and dense forests of tropical West Africa and the equally hot and heavily timbered lowlands of India and the Malay archipelago. In Arabia, the present dividing region, many of these genera are altogether wanting.

Pararge and *Phyllocharis*, palæarctic genera, may have entered the region in which they now occur by migration along the Nile. It is quite different with the genus *Brenthis*, which occurs isolated upon the slopes of Kenia, Kilimanjaro, and Ruwenzori, the lofty volcanic peaks which dominate the plains of eastern and southeastern Africa. The nearest locality in which this genus finds representation at the present time is in the Alps of Switzerland, the Himalayas in India, and the Andean region of Patagonia. That the genus *Brenthis* should occur on the lofty summits of the East-African mountains and be there as the result of a migration from Switzerland, the Himalayas, or Patagonia, under conditions such as exist at the present time, is an untenable hypothesis, which no student would venture to advocate. The occurrence of *Hypanartia* only in Africa and South America, and the existence in Africa of the genus *Crenis*, so closely related to the South American genus *Eunica*, as scarcely to be separable from it, are facts pointing strongly to the existence in some remote time of a land connection between the continents of Africa and South America. Correlated with the facts as to the distribution of these genera of butterflies is the fact that in the avifauna of Africa and South America we find the *Struthionidæ*, or ostriches represented in both localities, and the species of the genus *Rhipsalis*, of the Opuntieæ occurring in the Cameroons and Madagascar, are witnesses in the floral world to the ancient bond between two now widely separated continents. To these facts cited by our author the writer may add the fact that in the elder groups of the arthropoda, as for example the Phrynidæ, similar instances of the occurrence of closely related forms in Africa and tropical America occur. These things all go to confirm the view which is coming to be generally held by geologists and paleontologists upon apparently strong and sufficient grounds, that in the mesozoic and elder tertiary, a union between the Eastern and Western Hemispheres existed by means of an Antarctic continent, which has largely disappeared, but which at that time, in some way united Africa and Madagascar, and very probably likewise Australia, to the land-mass now known as South America.

Under the head of 'Mimicry' the author gives a list of forty-nine species which are mimicked and sixty-six species which mimick them. It is very doubtful whether this list is correct in representing certain species as mimes, especially where a species of *Terias* is represented as mimicking a *Pieris*, or a *Catopsilia* the female of *Teracolus*. The cases cited, with which the present writer is very familiar, do not come under the head of 'protective mimicry' at all, but fall into the common category of general resemblance or family likenesses. This part of the work, while interesting, gives evidence of less care in preparation and less familiarity with essential facts than any other part of the work.

Upon the whole the student of African entomology has great reason to be grateful to Professor Aurivillius for having had the patience and zeal to prepare this monumental volume, which must for years to come serve as a key for unlocking the treasures of knowledge as to the butterfly-fauna of the Dark Continent.

W. J. HOLLAND.
WESTERN UNIVERSITY OF PENNSYLVANIA,
February 24, 1900.

Zoological Results based on Material from New Britain, New Guinea, Loyalty Islands and elsewhere, collected during the years 1895, 1896 and 1897, by Arthur Willey. Cambridge, Eng., the University Press. 4to. Part III., May, 1899; pp. 207–356; plates XXIV.–XXXIII.

Part III. of Dr. Willey's 'Zoological Results' opens with an account by Gadow of the variations in the number and arrangement of the

scutes on the carapace of the loggerhead turtle. The material consisted in part of twenty specimens of new-born loggerheads all taken from one nest in New Britain and all showing abnormal numbers of scutes. This was supplemented by fifty-six other specimens from various collections, making in all a total of seventy-six individuals examined. The typical arrangement of the scutes on the loggerhead is as follows: The chief axis of the carapace is covered by six median elements; these are flanked by five pairs of costals; and the edges of the carapace are bounded by thirteen pairs of marginals. In studying the variation of these parts, Gadow has confined his attention to the median and costal elements. The variations in these series took the form of supernumerary scutes. Thus the total number of median elements may rise from six to seven or eight, and of costal elements on a given side from five, to six, seven, or even eight. In the costal scutes the variations were in some instances symmetrical, in others unsymmetrical. It will be observed that all these variations lie above the normal, and, as there is reason for believing that primitive turtles had a greater number of scutes than modern ones, Gadow holds that these variations are to be interpreted as atavistic. According to his belief, the ancestral turtles possessed at least eight median and eight pairs of costal plates. The reduction of these by which the condition in the loggerhead was reached, as indicated by the variations observed, was as follows: Of the original eight median scutes, the seventh was probably the first to disappear, followed by the fifth, thus giving rise to the series of six, typical for the loggerhead; of the original eight pairs of costals, the second pair was probably first lost, then the fifth and, by the fusion of the seventh and eighth, the condition of five pairs characteristic for this species was reached. For variations of this atavistic kind, Gadow, without further comment, proposes the term orthogenetic, a rather summary procedure in our opinion, since this term has already been extensively employed by Eimer for a different phenomenon. More or less looseness, however, pervades the whole paper and appears strikingly in the diagrammatic figures VII. and VIII. (p. 217), which, though intended to make the subject clear, really lead to confusion from the fact that the system of cross-hatching adopted is incorrectly used. It is to be regretted that a little more care was not exercised in the preparation of what is otherwise an interesting and valuable contribution.

The second paper in this part is by Dr. Willey himself and deals with the South Pacific and West Indian Enteropneusta. To the five species of these worm-like animals previously known from the region in which Dr. Willey collected, three new species are added. Two other new species from the West Indies are also described. The paper contains a synopsis of the families and genera of the Enteropneusta and a full description of the new species. These organisms are of importance because of their supposed relation to vertebrates, and the concluding part of Willey's paper deals with their morphology from this standpoint. A comparison of the central nervous organs, of the supporting axis of the body, of tubules kidney-like in character, and of the gills in the Enteropneusta, the tunicates, and the vertebrates confirm the belief in the natural affinities of these three groups of animals. In the course of this discussion the author suggests the novel idea that the genital glands and gill-slits were primarily unlimited in number and coextensive in distribution, and that the primary function of the gill-slits was the oxygenation of the genital glands, their secondary function being the respiration of the individual.

The concluding paper is by Shipley and deals with the five species of Echinoids collected by Willey. A revision of this group of worms is given together with an account of their geographical distribution.

G. H. Parker.

Minnesota Plant Life. By Conway MacMillan. Report of the Survey; Botanical Series, III. St. Paul, Minnesota, October 30, 1899. Octavo, 568 pages.

This is probably the most remarkable State report ever published. The author has given to the world a thoroughly scientific treatise, which is a contribution to our knowledge of the flora of Minnesota, and yet he has done so in such a way that, at the same time, the volume

is one of the most popular of the State reports. This fact alone would mark the book as one of the most notable of recent publications, but when we add the beauty of its typography and illustrations, excellence of paper, and perfection of printing, so generally wanting in State Reports, we are doubly surprised. It is encouraging to find an author, who is an acknowledged master of the vocabulary of technical science, who here shows that he is equally at home in the non-technical presentation of strictly scientific facts in a somewhat new field of botany, and to learn that even State printing may be brought to compete successfully with the finest work done in private establishments. This volume is thus a distinct gain along more than one line.

The purpose of the book cannot be told better than in the author's own words: "In the pages of this book I hope to give the reader an idea of the diversified plant life which occupies the air, the soil and the waters of Minnesota. First of all, it must be remembered that plants, although passive creatures, are quite as truly living beings as are the more active animals. Just as men and women, either themselves or their ancestors, have entered the state from some other region, so also have plants, according to the nature of each, found their way and selected their abodes. It is no easy problem to determine why some family has chosen one village rather than another. This may have been from causes which are too subtle or too remote for analysis, but it is recognized that people have not come to make their homes without some reason which seemed sufficient to them or to their forefathers. So, too, there is always some reason for the appearance at a particular spot of one kind of plant rather than another, and it is possible, in a general way, to explain the vegetation of the hills and meadows of the state" (page 1).

Then follow simple discussions of the geography, climate and physical history of Minnesota, the laws of plant distribution, plant zones, the forests of Minnesota and the world, the North American flora, plant wanderings and migrations, associations between migrating plants, struggles of migrating plants, etc.

In speaking of the number of species of plants, the author estimates that of the 300,000 now living, about 7500 are probably to be found growing without cultivation in Minnesota, and distributes them approximately as follows: Slime moulds (which later he says are 'more probably animals') 150; bacteria and algæ, 1000; fungi and lichens, 3250; liverworts and mosses, 500; ferns and flowering plants, 2600.

Thirty-seven chapters are given to a general account of the vegetation of the State, under such heads as 'Slime Moulds and Blue-green Algae,' 'The lower sorts of Fungi,' 'Carrion-Fungi and Puff-balls,' 'Lichens and Beetle-fungi,' 'Mosses and Liverworts,' 'Ferns and Water-ferns,' 'Ground-hemlocks and various Pines,' 'Grasses and Sedges,' 'Poplars and Willows,' 'Roses, Peas and their Relatives,' 'Wintergreens to Chaffweeds,' 'Peppermints to Plantains,' 'Dandelions, Ragweeds and Thistles.'

The remaining chapters (XL. to XLV.) are devoted to a general discussion of the ecological problems involved in a full understanding of the flora. One of these takes up 'Adaptations of Plants to their Surroundings,' in which the several factors, Gravity, Mechanical Forces, Heat, Light, Moisture, Electricity and Magnetism, the Soil or Substratum, Other Living Things, and Intra-specific Adaptations are discussed. Another is given to Hydrophytic Plants, another to Xerophytic Plants, and still another to Halophytes and Mesophytes. These chapters, in spite of their titles, are very simply treated, and may be read easily by any person of average ability. The closing chapters are more philosophical and are devoted to the Maintenance of the Plant Individual, and the Maintenance of the Plant Species.

The author has certainly succeeded "in portraying the vegetation of Minnesota as an assemblage of living creatures, as a world of infinite variety, yet with a fundamental unity of plan, as forms linked together in structure, function and adaptation," and he has done so in language so simple, and yet so precise as to afford to us a new suggestion as to the presentation of scientific matter for the public. There is here left no opportunity for the shallow book-writer to take the author's results and

work them over into more popular form, with the inevitable errors, inaccuracies and misrepresentations which characterize such productions. Professor MacMillan has wisely chosen to supply his own popular edition.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for February has for its first article a paper by Henry Fairfield Osborn on 'The Angulation of the Limbs of Proboscidia, Dinocerata and other Quadrupeds in Adaptation to Weight.' Stephen R. Williams discusses 'The Specific Gravity of some Fresh Water Animals in Relation to their Habits, Development and Composition,' the conclusion being that the movements of an animal are closely related to its density and this in turn to its food habits. Carl H. Eigenmann and George Daniel Shafer describe 'The Mosaic of Single and Twin Cones in the Retina of Fishes,' Thomas H. Montgomery has a 'Note on the Genital Organs of Zaitha,' and Maynard M. Metcalf in 'Willey on the Enteropneusta' directs attention to some of that author's far-reaching theoretical conclusions. The 'Synopses of North American Invertebrates' are again continued, Mary J. Rathbun contributing the seventh part on the Cyclometopous or Cancroid Crabs. The balance of the number is occupied with reviews of recent literature.

IN *The Osprey* for February, Paul Bartsch continues his 'Birds of the Road,' and under 'Esthetic Birds' is given Beccari's account of the Gardener Bird of New Guinea. Eugene S. Rolfe presents 'Nesting Notes on the Waders of the Devil's Lake Region,' and W. E. Clyde Todd has an excellent article on 'The Requirements of a Faunal List,' while Philo W. Smith, Jr., describes the 'Nesting of Stephen's Whip-poor-will.' The editor contributes some valuable comments on 'The Origin of the Hawaiian Fauna,' and there are some interesting letters and notes.

THE *Journal of the Boston Society of the Medical Sciences* for January 16th, has for its leading article a paper by Theobald Smith on 'Variation among Pathogenic Bacteria,' a subject to which Dr. Smith has paid particular attention for many years. As he states, on the one hand the element of variability has been overlooked, and on the other hand the tendency to concede to bacteria any degree of variability, has given rise to theories which leave but little importance to pathogenic bacteria in the ætiology of disease. The writer concludes that since new disease germs are not constantly appearing the inference is that most species cannot adapt themselves to a parasitic existence. Mark W. Richardson has a note 'On the Cultivation of the Typhoid Bacillus from Rose Spots'; E. W. Taylor describes a case of 'Gumma of the Oblongata,' remarkable for the location and size of the tumor, and James H. Wright notes 'A Simple Method for Anaërobic Cultivation in Fluid Media.'

A Revue des revues d'histoire naturelle has been established at Paris under the direction of MM. Coupin and de Courdirban. It is published bi-monthly.

DR. A. S. EAKLE, assistant in mineralogy at the University Museum, has become the American editor for Groth's *Zeitschrift für Krystallographie.*

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF BIOLOGY.

AT the meeting of February 12, 1900, presided over by Professor Bashford Dean, the following program was offered:

J. A. MacGregor, 'On the Development of the Skull in Ceratodus.'

F. B. Sumner, 'Kupfer's Vesicle in Relation to Gastrulation and Concrescence.'

G. S. Huntington, 'Some Muscle Variations of the Pectoral Girdle.'

J. H. MacGregor gave a brief preliminary report on the development of the skull in Ceratodus, the Australian lung-fish. The research was made conjointly with Professor Bashford Dean.

Only the early stages of the chondrocranium have as yet been studied; but it is noteworthy that these early stages show even closer resemblance to the amphibian skull than does the adult. The suspensorium is autostylic from the

first, and the union of quadrate to cranium by ascending and otic processes is exactly as in urodele amphibia. The hyomandibular appears later than the body of the hyoid arch, and has no connection with the jaws. The trabeculæ are widely separated, leaving a large ventral fontanelle, also an amphibian character. The palatopterygoid bar is almost entirely suppressed. The one character which is entirely fishlike is the otic capsule.

A summary of Mr. Sumner's paper is as follows:

I. The generally accepted account of the gastrulation in the Teleosts as proposed first by Götte, was shown to be incomplete, in so far as it failed to give a true account of the hypoblast.

II. A view of Kupfer's vesicle was maintained, closely similar to that proposed by the great morphologist after whom the structure has been named.

III. The present author has arrived, on purely morphological grounds, at a view of concrescence identical with that proposed by Kopsch on the basis of the latest experimental work.

Dr. George S. Huntington's paper dealt specifically with the retro-clavicular group of supernumerary muscles, for the purpose of determining their mutual relationship and common derivation. The new muscle, here described for the first time, completes a series of retro-clavicular aberrant muscles which represent different stages in migration and recession of the typical mammalian M-sterno-chondro-scapularis. The members of this group appear therefore as myo-typical reversions representing persistent portions of this muscular plane, with secondary skeletal attachments depending upon the degree of recession.

FRANCIS E. LLOYD,
Secretary.

SECTION OF GEOLOGY AND MINERALOGY.

AT the meeting of February 19, 1900, with Mr. G. F. Kunz in the chair, there were sixteen persons present.

Professor R. E. Dodge announced the death of Dr. Hans Bruno Geinitz on December 30, 1899. He also stated that Professor J. J. Stevenson had been appointed by the Council of the Academy as delegate to the coming meeting of the International Geological Congress, and that the Council had voted to become a subscriber to the fund of that Congress.

The Chairman briefly discussed the character and work of Dr. Geinitz, and, on motion, Professor Stevenson was appointed a committee to prepare a minute on this great loss to the Academy and to science.

The following specimens were exhibited by the Chairman:

Corundum from Raglan Township, Ontario, Canada.

Variously colored sapphires from a new locality, Clear Creek, Granite county, Montana.

Corundum from a serpentine dike at a new locality, Corundum Hill, Plumas county, California.

The regular paper of the evening was then read by Dr. Henry S. Washington, illustrated by diagrams and specimens:

'The Igneous Complex of Magnet Cove, Arkansas.' The structure of the complex is described and, from the evidence of the form of the area, the relations to the surrounding shales, the presence of an overlying zone of metamorphosed rock, the arrangement of, and the serial petrographical and chemical characters of the main rock types, with other minor points, the conclusion is drawn that the igneous complex is probably a laccolith, and certainly a unit; and that the main component abyssal rocks are not due to successive injections, as was suggested by J. F. Williams, but are the result of a differentiation *in situ* of the mass of magna.

The main rock types are described, some new analyses being given, and they are shown to form a regularly graded series of interesting rocks, ranging from basic jacupirangite, through biotite-ijolite, typical ijolite, shonkinitic syenite and leucite-syenite, to foyaite. This serial, and common genetic character is shown both mineralogically and chemically. It is probable that the dikes of tinguaite and nepheline-porphyry are aschistic, while those of monchiquitic rocks are diaschistic.

The arrangement of the abyssal rocks is shown to differ radically from most other cases of differentiated laccolithic masses and dikes, in that there is progressive increase in acidity

toward the periphery. One or two other instances of this are mentioned, the most closely analogous being the laccolith at Umptek in Kola (Finland).

An explanation of this is given, based on a process of fractional crystallization or freezing of the magma, and the idea applied to other cases. It is suggested that the laccoliths and similar magnetic masses, which have been studied, may be referred to three distinct types, the differences between which would be satisfactorily accounted for by the hypothesis.

In the ensuing discussion Dr. Washington pointed out that the specimens of the rocks represented by his analysis had not been selected in a radial line, but at various directions at increasing distances from the central mass of basic constitution.

Alexis A. Julien,
Secretary of Section.

TORREY BOTANICAL CLUB.

At the meeting of January 31, 1900, six new members were elected.

The scientific program consisted of a paper on the cultivation of palms, by Mr. Henry A. Siebrecht. After a general discussion of the palms as a botanical group, and of the various types represented in tropical regions, a full and interesting account was given of their cultivation in conservatories and as house plants, with valuable suggestions for their treatment and care in the household. The characters of various species suitable for cultivation indoors were given, especially of the genera *Cocos*, *Kentia*, *Phœnix*, *Areca*, *Caryota*, *Licula* and *Thrinax*, of which fine illustrations were shown from Mr. Siebrecht's nurseries. Among these were *Cocos Weddelliana*, *Phœnix Canariensis*, *P. Rupicola*, *Areca lutescens* and *Licuala grandis*. An acconnt of Mr. Siebrecht's extensive nurseries in the tropical regions of Trinidad was afterwards added by request of some of the members.

Discussion followed by Mr. Henshaw, Mr. Lighthipe and Dr. Rusby.

L. M. Underwood,
Secretary pro. tem.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 513th meeting of the Society was held at the Cosmos Club on February 17th. Professor T. J. J. See, of the Naval Observatory, on behalf of the committee on Mathematical Science, presented a brief report on the progress of Theoretical Astronomy during 1899. Attention was drawn to the completion of *M. Poincaré's Méthodes nouvelle de la mécanique*, a work of the highest theoretical interest, and promising important practical extension in certain directions. It seemed probable that the methods depending on periodic solutions will be of much greater use in connection with the theories of stability and limits of variations, than in the practical construction of tables.

The progress of the Lunar Theory in the hands of Professor E. W. Brown was noted, and attention was drawn to the necessity for a practical test of the theory in the way of the construction of new tables for the Moon. The speaker thought the Nautical Almanac Office might take up the Lunar Theory in the near future as one of its principal lines of work.

The report noted the progress of Professor Eichelberger's researches on the tables of the Watson Asteroids, and Professor Stone's researches on the theory of the perturbation of Hyperion. Attention was also called to Professor Brown's researches on the satellite of Neptune, which enabled him to deduce the oblateness of the planet from its perturbative effect on the motion of the Satellite.

Professor See referred to his own researches on the Sun's heat, recently published by the Academy of Science of St. Louis, and said he had some investigations in progress which would give more accurate theories of the densities and moments of inertia of the planets. In conclusion it was pointed out that if no discovery of an especially striking character had been made during the past year, it was apparent that the progress was steady and continuous, and touched some of the most delicate problems of the heavens.

Mr. Henry Farquhar read a paper on the 'Formation of a table of nth powers by means of their successive differences.' A rule was given and demonstrated for calculating any power of the natural series of numbers from 0 upwards, by simple addition, combined with multiplication by factors in no case exceeding the index

of the power. The first number in the series of first differences is always 1; the first in that of the second differences the difference between $2^n - 1$, and 1 or $2^n - 2$; while the third series is evidently headed by $3^n - 3 \cdot 2^n + 3$, the fourth by $4^n - 4 \cdot 3^n + 6 \cdot 2^n - 4$, and the q^{th} by

$$q^n - q(q-1)^n + \frac{q(q-1)}{2}(q-2)^n - \frac{q(q-1)(q-2)}{2 \cdot 3}(q-3)^n + \cdots$$

The derivation of these numbers for the nth power from similar numbers for the $n-1$th power is very simple, since

$$q^n - q(q-1)^n + \frac{q(q-1)}{2}q-2)^n - \cdots = q\Big[q^{n-1} - q(q-1)^{n-1} \cdot + \frac{q(q-1)}{2}(q-2)^{n-1} - \cdots + (q-1)^{n-1} - (q-1)(q-2)^{n-1} + \cdots\Big]$$

The table below shows the succession of leading differences for each power as far as the fifth; figures in the column to the left denoting powers, and each number in the body of the table being the sum of that immediately above it and that immediately to the left of the latter, multiplied by the factor at the head of its column. The calculation of a table of fourth powers is also indicated to the right; the numbers at the top being taken from the preceding table, and each of the rest being the sum of that immediately above it and that immediately to the right of the latter. The number 24, in the last column, is a constant additive to the column preceding. The successive fourth powers appear in the left-hand column of the calculation.

	1	2	3	4	5
1	1	.	.	.	.
2	1	2	.	.	.
3	1	6	6	.	.
4	1	14	36	24	.
5	1	30	150	240	120

.	.	1	14	36	24
1	1	15	50	60	.
2	16	65	110	84	.
3	81	175	194	108	
4	256	369	302		
5	625	671			
6	1296				

A paper by Mr. J. R. Eastman on the 'Treatment of Reflection Observations at Greenwich Observatory,' announced for the evening, was not read on account of the unavoidable absence of the author.

E. D. PRESTON,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

THE 98th regular meeting was held at the Cosmos Club, February 28, 1900.

Under informal communications Mr. G. K. Gilbert called attention to the peculiar level character of the ledges of rock crossing the bed of the Potomac, just above Harpers Ferry, and also in the bed of the Columbia river, near the mouth of the Umatilla. It was suggested that subaërial disintegration is effective in reducing, to approximately the water level, those portions of the rocky bed which are not ordinarily covered with water.

On the regular program Mr. W J McGee presented a paper on 'The Gulf of California as an Evidence of Marine Erosion.' It was shown that the powerful tides of the Gulf, aided by frequent gales, are the cause of vigorous marine erosion where the tidal currents are constricted by the islands Tiburon, Esteban, and San Lorenzo. The erosion results in submarine terraces, up to a mile in width, covered with shallow water, and backed by precipitous coastal cliffs. At the outer edges of these terraces there is a rapid descent into deep water.

A discussion on 'The Conditions of Formation of Conglomerates, and Criteria for distinguishing between Lacustrine and Fluviatile Beds,' was introduced by a paper from Professor W. M. Davis, briefly summarizing the criteria available for discriminating the two classes of deposits, and suggesting that the term *continental* proposed by Penck, should be used in those cases where it is not possible to determine whether a given deposit is lacustrine or fluviatile.

Mr. G. K. Gilbert followed with a short analysis of the conditions governing the formation of conglomerates. The dominant agencies are littoral and fluviatile. Hence the presence of conglomerates, in the absence of contrary evidence, indicates stream or shore action. The formations of Lake Bonneville and the superficial deposits of the Great Plains were determined as lacustrine and fluviatile respectively, not from the internal evidence of the deposits, but on physiographic grounds.

Mr. S. F. Emmons, referring especially to the regions covered by the Fortieth Parallel

Survey, stated that a fluviatile origin for the tertiary beds of the west was not considered, because their lacustrine nature was indicated by physiographic evidence.

Mr. Whitman Cross cited Blanford's description, published in 1879, of the Gondwána beds in India, and pointed out that the conclusion, then announced, as to the probable origin of these and other beds in India had probably been overlooked by geologists quite generally. The same criteria applied to the tertiary and mesozoic beds of the Rocky Mountain region would lead to the conclusion that many of them were of fluviatile origin. Mr. Cross, however, questioned the value of the criteria employed by Blanford, Penck and Davis, and would give most weight at present to the extent and distribution of the formations in question, and their relation to continental areas.

Mr. Bailey Willis remarked that he had been in the habit of reasoning back from conglomerates in order to reconstruct former physiographic conditions. Thus the conglomerate of the Puget Sound Basin, covering perhaps 10,000 square miles, was formed by glacial streams in Pleistocene time. The Pliocene conglomerates of California are delta deposits and are associated with uplift. The Eocene conglomerate of Washington State was laid down at the foot of steep bluffs of granite. The Pottsville conglomerate, composed almost wholly of residual quartz and widely distributed, can have been derived only from a coastal plain where it had been concentrated by marine action, and thence distributed by marine or fluviatile currents.

Mr. G. F. Becker pointed out that a lake was often only an expanded river and suggested that a more useful distinction than that between lacustrine and fluviatile deposits, would be one between materials laid down in rapidly moving and in comparatively still water. Deposits laid down by streams have their particles imbricated in one dominant direction. Beach deposits are capriciously imbricated and their pebbles are asymmetric.

F. L. Ransome,
David White,
Secretaries.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 319th meeting was held on Saturday evening, February 24th. W. A. Orton spoke of 'The Sap Flow of the Maple in Spring,' describing a series of experiments undertaken with a view of ascertaining the cause of the the phenomenon. The results showed that it was due to plant physics rather than plant physiology, and had a direct relation to temperature, the sap being expelled by the expansion, caused by warmth, of the gas contained in the wood cells. M. B. Waite described 'The Peach Orchards of Michigan,' stating that they were located on the eastern shore of Lake Michigan, this body of water having the effect of mitigating the temperature of the region. Most of the farms, the speaker stated, were comparatively small, running from fifty to eighty acres in size, but owing to the methods of cultivation they yielded a good profit. Various methods of cultivation were discussed and the speaker touched briefly upon the disease of the peach known as 'little peach.' Both papers were illustrated by lantern slides.

F. A. Lucas.

DISCUSSION AND CORRESPONDENCE.

INFINITESIMALS.

To the Editor of Science: Will you kindly accord me space for a few remarks about Infinity and Continuity which I seem called upon to make by several notes to Professor Royce's Supplementary Essay in his strong work 'The World and the Individual'? I must confess that I am hardly prepared to discuss the subject as I ought to be, since I have never had an opportunity sufficiently to examine the two small books by Dedekind, nor two memoirs by Cantor, that have appeared since those contained in the second volume of the *Acta Mathematica*. I cannot even refer to Schröder's Logic.

1. There has been some question whether Dedekind's definition of an infinite collection or that which results from negativing my definition of a finite collection is the best. It seems to me that two definitions of the same conception, not subject to any conditions, as a figure in space, for example, is subject to geometrical conditions, must be substantially the

same. I pointed out (*Am. Journ. Math.* IV. 86, but whether I first made the suggestion or not I do not know) that a finite collection differs from an infinite collection in nothing else than that the syllogism of transposed quality is applicable to it (and by the consequences of this logical property). For that reason, the character of being finite seemed to me a positive extra determination which an infinite collection does not possess. Dr. Dedekind defines an infinite collection as one of which every *echter Theil* is similar to the whole collection. It obviously would not do to say a *part*, simply, for every collection, even if it be infinite, is composed of individuals; and these individuals are parts of it, differing from the whole in being indivisible. Now I do not believe that it is possible to define an *echter Theil* without substantially coming to my definition. But, however that may be, Dedekind's definition is not of the kind of which I was in search. I sought to define a finite collection in logical terms. But a 'part,' in its mathematical, or collective, sense, is not a logical term, and itself requires definition.

2. Professor Royce remarks that my opinion that differentials may quite logically be considered as true infinitesimals, if we like, is shared by no mathematician '*outside of Italy.*' As a logician, I am more comforted by corroboration in the clear mental atmosphere of Italy than I could be by any seconding from a tobacco-clouded and bemused land (if any such there be) where no philosophical eccentricity misses its champion, but where sane logic has not found favor. Meantime, I beg leave briefly to submit certain reasons for my opinion.

In the first place, I proved in January, 1897, in an article in the *Monist* (VII. 215), that the multitude of possible collections of members of any given collection whatever is greater than the multitude of the latter collection itself. That demonstration is so simple, that, with your permission, I will here repeat it. If there be any collection as great as the multitude of possible collections of its members, let the members of one such collection be called the A's. Then, by Cantor's definition of the relation of multitude, there must be some possible relation, r, such that every possible collection of A's is r to some A, while no two possible collections of A's are r to the same A. But now I will define a certain possible collection of A's, which I will call the collection of B's, as follows: Whatever A there may be that is not included in any collection of A's that is r to it, shall be included in the collection of B's, and whatever A there may be that is included in a collection of A's that is r to it, shall not be included in the collection of B's. If there is any A to which no collection of A's stands in the relation r, I do not care whether it is included among the B's or not. Now I say the collection of B's is not in the relation r to any A. For every A is either an A to which no collection of A's stands in the relation r, or it is included in a collection of A's that is r to it, or it is excluded from every collection of A's that is r to it. Now the collection of B's, being a collection of A's, is not r to any A to which no collection of A's is r; and it is not r to any A that is included in a collection of A's that is r to it, since only one collection of A's is r to the same A, so that were that the case the A in question would be a B, contrary to the definition which makes the collection of B's exclude every A included in a collection that is r to it; and finally, the collection of B's is not r to any A not included in any collection of A's that is r to it, since by definition every such A is a B, so that, if the collection of B's were r to that A, that A would be included in a collection of A's that was r to it. It is thus absurd to say that the collection of B's is r to any A; and thus there is always a possible collection of A's not r to any A; in other words, the multitude of possible collections of A's is greater than the multitude of the A's themselves. That is, every multitude is less than a multitude; or, there is no maximum multitude.

In the second place I postulate that it is an admissible hypothesis that there may be a something, which we will call a *line*, having the following properties: 1st, points may be determined in a certain relation to it, which relation we will designate as that of 'lying on' that line; 2d, four different points being so determined, each of them is separated from one of the others by the remaining two; 3d, any three points, A, B, C, being taken on the line, any multitude whatever of points can be deter-

mined upon it so that every one of them is separated from *A* by *B* and *C*.

In the third place, the possible points so determinable on that line cannot be distinguished from one another by being put into one-to-one correspondence with any system of 'assignable quantities.' For such assignable quantities form a collection whose multitude is exceeded by that of another collection, namely, the collection of all possible collections of those 'assignable quantities.' But points are, by our postulate, determinable on the line in excess of that or of any other multitude. Now, those who say that two different points on a line must be at a finite distance from one another, virtually assert that the points are distinguishable by corresponding (in a one-to-one correspondence) to different individuals of a system of 'assignable quantities.' This system is a collection of individual quantities of very moderate multitude, being no more than the multitude of all possible collections of integral numbers. For by those 'assignable quantities' are meant those toward which the values of fractions can indefinitely approximate. According to my postulate, which involves no contradiction, a line may be so conceived that its points are not so distinguishable and consequently can be at infinitesimal distances.

Since, according to this conception, any multitude of points whatever are determinable on the line (not, of course, by us, but of their own nature), and since there is no maximum multitude, it follows that the points cannot be regarded as constituent parts of the line, existing on it by virtue of the line's existence. For if they were so, they would form a collection; and there would be a multitude greater than that of the points determinable on a line. We must, therefore, conceive that there are only so many points on the line as have been marked, or otherwise determined, upon it. Those do form a collection; but ever a greater collection remains determinable upon the line. *All* the determinable points cannot form a collection, since, by the postulate, if they did, the multitude of that collection would not be less than another multitude. The explanation of their not forming a collection is that all the determinable points are not individuals, distinct, each from all the rest. For individuals can only be distinct from one another in three ways: First, by acts of reaction, immediate or mediate, upon one another; second, by having *per se* different qualities; and third, by being in one-to-one correspondence to individuals that are distinct from one another in one of the first two ways. Now the points on a line not yet actually determined are mere potentialities, and, as such, cannot react upon one another actually; and, *per se*, they are all exactly alike; and they cannot be in one-to-one correspondence to any collection, since the multitude of that collection would require to be a maximum multitude. Consequently, all the possible points are not distinct from one another; although any possible multitude of points, once determined, become so distinct by the act of determination. It may be asked, "If the totality of the points determinable on a line does not constitute a collection, what shall we call it?" The answer is plain: the possibility of determining more than any given multitude of points, or, in other words, the fact that there is room for any multitude at every part of the line, makes it *continuous*. Every point actually marked upon it breaks its continuity, in one sense.

Not only is this view admissible without any violation of logic, but I find—though I cannot ask the space to explain this here—that it forms a basis for the differential calculus preferable, perhaps, at any rate, quite as clear, as the doctrine of limits. But this is not all. The subject of topical geometry has remained in a backward state because, as I apprehend, nobody has found a way of reasoning about it with demonstrative rigor. But the above conception of a line leads to a definition of continuity very similar to that of Kant. Although Kant confuses continuity with infinite divisibility, yet it is noticeable that he always defines a continuum as that of which every part (not every *echter Theil*) has itself parts. This is a very different thing from infinite divisibility, since it implies that the continuum is not composed of points, as, for example, the system of rational fractions, though infinitely divisible, is composed of the individual fractions. If we define a continuum as that every part of which can be

divided into any multitude of parts whatsoever —or if we replace this by an equivalent definition in purely logical terms—we find it lends itself at once to mathematical demonstrations, and enables us to work with ease in topical geometry.

3. Professor Royce wants to know how I could, in a passage which he cites, attribute to Cantor the above opinion about infinitesimals. My intention in that passage was simply to acknowledge myself, in a general way, to be no more than a follower of Cantor in regard to infinity, not to make him responsible for any particular opinion of my own. However, Cantor proposed, if I remember rightly, so far to modify the kinetical theory of gases as to make the multitude of ordinary atoms equal to that of the integral numbers, and that of the atoms of ether equal to the multitude of possible collections of such numbers. Now, since it is essential to that theory that encounters shall take place, and that promiscuously, it would seem to follow that each atom has, in the random distribution, certain next neighbors, so that if there are an infinite multitude in a finite space, the infinitesimals must be actual real distances, and not the mere mathematical conceptions, like $\sqrt{-1}$, which is all that I contend for.

C. S. PEIRCE.

MILFORD, PA., Feb. 18, 1900.

CURRENT NOTES ON PHYSIOGRAPHY.

DEFLECTION OF RIVERS BY SAND-REEFS.

AN article on 'The effect of sea barriers upon ultimate drainage' by J. F. Newsom (*Journ. Geol.*, vii, 445–451), describes several examples of rivers whose discharge is deflected to the right or left by the formation of an offshore sand-reef in front of their mouths, and suggests that such deflection may explain the course of rivers that now flow parallel to preexistent coast lines; for example, the Delaware below Bordentown, N. J.

This suggestion is evidently valid as a possibility, but it is not accompanied by tests that sufficiently distinguish deflections thus caused from deflections that arise from the spontaneous adjustment of streams to the weak strata that underlie the cuesta-makers of coastal plains having longitudinal relief. The lower Delaware cannot be a normal example of the latter class, because as the master river of its region it is the very one that should not be deflected by adjustment; on the other hand, it may truly fall under the former class because its deflection is in the sense of the dominant sand-drift along our Atlantic Coast. Examples of sand-reef deflections ought to follow the strike of strong or weak rocks, indifferently; while normal deflections by adjustment can only follow belts of weak rocks.

DEVELOPMENT OF THE SEVERN.

THE systematic development of rivers seldom finds better illustration than in the interaction of the 'waxing Severn and the waning Thames,' concerning which a number of new details and suggestions are given by S. S. Buckman (*Nat. Science*, xiv, 1899, 273–289). The growth of the Severn by headward erosion along the weaker strata that underlie the firmer oölites of the Cotteswold hills is advocated on good evidence, and a restoration of the original consequent headwaters that have now been diverted from the Thames system is attempted. The growth of obsequent branches of the subsequent Severn on the line of the beheaded consequent branches of the Thames is well presented as the reason for the peculiar unsymmetrical arrangement of the Severn tributaries in the neighborhood of Gloucester. The Frome, a branch of the Severn, is shown to have captured several of the westernmost headwaters of the Thames in the Cotteswold hills between Chalford and Edgeworth. The progressive diminution of the Coln, a branch of the Thames, by the successive diversion to the Severn of the two large branches that once came from Wales is offered in explanation of the very curious features of the present Coln valley in the upland east of Cheltenham: a valley of large-curve meanders is taken as the work of the original river; a narrower valley of small meanders, cut in the floor of the larger valley, is the work of the river after one of its upper branches was captured by the Severn; the wriggling course of the present stream on the floor of these smaller meanders is due to the further loss of volume after the second upper branch was captured.

Some further account of the Cotteswold streams and of their homologues in the Swabian Alp of southern Germany may be found in a paper by the undersigned on the 'Drainage of Cuestas' (Proc. Geol. Assoc., London, xvi, 1899, 75–93). The failure of even the obsequent streams fully to occupy their meandering valleys suggests that all the streams of the region have diminished in volume on account of climatic change or of deforesting and cultivation; beheading is therefore not alone the cause of the misfit of the Coln and its neighbors in the upper Thames system.

LANDQUART AND LANDWASSER.

Heim's explanation of the diversion of the upper waters that once belonged to the Landwasser by the headward growth of the Landquart in the Alps of eastern Switzerland has been made familiar in Lubbock's 'Scenery of Switzerland.' A serious difficulty that stands in the way of this explanation is presented by A. V. Jennings (*Geol. Mag.*, London, 1899, 259–270); namely, that the growth of the Landquart before its capture of the upper Landwasser would have had to be through a belt of resistant rocks, which usually rise high in ridges and peaks. If the capture really took place, it seems to have been long ago, for the divide at the head of the Landwasser appears to be formed not of bed rock as Heim implies, but of heavy morainic deposits by which certain streams, once captured by the Landquart, are now returned to the Landwasser.

Certain lines of evidence that might be found in connection with the form and attitude of the valley floors before the time of capture are not mentioned.

RIVER GORGES OPPOSITE LATERAL FANS.

A journey in Bokhara by Rickmers (*Geogr. Journ.*, xiv, 1899, 596–620) led to the headwaters of the Oxus, where a great body of conglomerates is deeply dissected, producing bad lands on a gigantic scale well illustrated by figures from photographs. The relation of the conglomerates to the lofty snow mountains further east suggests that the former represent an ancient 'wash' from the latter, the whole region now being uplifted and trenched. The local stream in a branch valley of the Yakh river excited the curiosity of the traveller by alternately passing through open basins and narrow rock-walled gorges, and as Rickmers was 'unable to find any mention of a similar phenomenon in the literature on the subject,' especial description of these 'Dandushka barriers' is given. They appear to be examples of gorges produced by a stream that has been displaced from the axis of its valley by the growth of large lateral fans such as may be seen in the upper Engadine of Switzerland. They are, therefore, analogous to gorges due to local displacement and superposition of streams on rocky beds by the irregular distribution of glacial drift, but they are of peculiar interest from their spontaneous production by the interaction of different members of a single drainage system. Although such features of a valley are as well specialized as the thorns and galls of a twig, they are not likely to be given any conveniently designative name by British geographers, inasmuch as one of the honorary secretaries of the Royal Geographical Society recently takes occasion to say that "the invention of a new scientific word is always a positive evil, to be avoided if possible" (*Geogr. Journ.*, 1899, 658). On the supposition that nothing worth naming remains to be discovered in scientific geography, this dictum may have value; but a hundred years hence geographers will probably look on the geographical terminology of to-day as we do on that of our predecessors a hundred years ago, when atoll and caldera, mesa and canyon, moraine, drumlin, esker and kame had no place in the English language.

AN AVALANCHE TRACK ON MT. SHASTA.

Among many items of interest in the introductory pages of Merriam's 'Biological Survey of Mount Shasta' (U. S. Dept. Agric., *N. Amer. Fauna*, No. 16, 1899), is the account of the path formed by a recent avalanche that must have been of unusual size, through a forest of large firs. After gaining headway in descending from the upper slopes, the snow cut a broad swath through the huge trees, carrying their trunks forward over a gently sloping tract, and strewing hundreds of great logs 75 to 100 feet long and 3 or 4 feet in diameter, in confusion over the broad area where the

slide finally came to rest. Here a few trees that were left standing are deeply scarred 10 or 15 feet above the ground where they were struck by trunks that were carried forward over deep snow. A number of excellent heliotype views are given of the mountain, the frontispiece being particularly fine.

W. M. DAVIS.

ZOOLOGICAL NOTES.

REGENERATION AND LIABILITY TO INJURY.

IN a recent number of the *Anatomischer Anzeiger*, Professor T. H. Morgan gives an account of his later experiments on the regeneration of the appendages of the hermit-crab. It will be remembered that his first experiments, made at Woods Hole in 1898, showed that certain appendages, because of their protection within the mollusk shell in which the crab lives, regenerate after artificial amputation quite as readily as the more exposed appendages which in nature are constantly liable to injury, and which actually reveal a much higher percentage of injuries. This result was clearly at variance with the opinion of those who believe that there is a definite relation between the regenerative capacity of a part and its liability to injury.

Professor Weismann attempted to explain the phenomenon by attributing to the more or less protected appendages of the hermit-crab the inherited regenerative power of some remote ancestor—an ancestor which was not domiciled in a shell. Moreover, he thought the fact that the power of autotomy was possessed by the three anterior thoracic appendages—parts frequently subject to injury—and not possessed by the two protected posterior pairs, was evidence of the comparatively recent origin of autotomy, and the more remote origin of regeneration, Morgan having shown that the fourth and fifth pairs of legs do regenerate. In stating that "The adaptation for autotomy once gained, the power of regeneration had of necessity to become localized; that is to say, the apparatus necessary for it had to be transferred to those parts at which alone the breaking off of the the limb occurs," Professor Weismann gave, to use his form of expression, a new lead which Morgan has again followed in his series of experiments of the summer of 1899. These experiments show that the power of regeneration has *not* become localized, and that the first three thoracic legs can regenerate both when cut off proximal to, and when cut off distal to the breaking-point of autotomy. Moreover, the experiments of Morgan incidentally give additional reasons for his earlier conclusion that there is no relation between regeneration and liability to injury, for in removing the appendages, at a point proximal to the 'breaking-joint,' he laid bare a regenerative zone, which in a state of nature must almost never be called upon to exercise the function of repair.

Weismann's suggestion that in the last abdominal appendage the regenerated part would be renewed after the pattern of a tail-fin of the Macroura, rather than after the original pattern of a 'holdfast,' is shown not to be supported by the facts.

H. C. B.

COMFORT AND PRODUCTIVITY.

M. MAX GERARD, in the *Bulletin Scientifique*, of the University of Liege, January, 1900, shows the influence of the compensation of the workman upon the productivity of establishments, taking his data from Dechesne, Ansiaux, and Waxweiler. He places the values of services and products, as reported from the several countries, in certain cases, thus:

	Wages per diem.	Value of product: Labor per tonne.
United States.....	12.20 fr.	17.15 fr.
Great Britain	6.25 "	15.15 "
France.....	4.15 "	16.90 "
Belgium	3.20 "	10.50 "

It is thus found that the cost of the product is, as a rule, very slightly affected, in these different countries by the wages paid their workmen, and France, paying one third the wage given in the United States, finds the product to cost practically the same amount. Great Britain, paying one-half the wages paid in the United States, produces very little more cheaply. Belgium pays little more than one-fourth the wages ruling in similar establishments in America and the product costs two-thirds as much, and even this difference may be due, in some degree, to other conditions.

The author of the paper accounts for these facts by the interaction of wages and morale,

largely, partly by the better nutrition of the well-paid man and his improved strength and spirits and ambition. He states that the engineers building the railway from Paris to Rouen made the experiment of furnishing the same nourishing and plentiful diet to their French laborer as was demanded by and habitually supplied to the Englishman working beside him, with the result that, after a short time, the product of the two men became the same. The four cases above were selected from among establishments doing substantially the same sort of work and marketing practically the same quality of product.

"On ne peut expliquer ces faits que par la productivité élevée de l'ouvrier américain qui possède plus d'activité, plus de vigilance, plus d'application au travail que ses concurrents. Il est effectivement placé dans des conditions supérieure au point de vue matériel, intellectuel et moral."

Rankine, in his 'Prime Movers,' makes substantially the same enunciation of a principle, recognized by every experienced manager of works, when, referring to the physical working effect of men and beasts, he states that the daily product depends upon the "health, strength, activity and disposition of the individual," and on the "abundance and quality of food and air, the climate, and other external conditions."

R. H. Thurston.

SCIENTIFIC NOTES AND NEWS.

Mr. Dean C. Worcester, assistant professor of zoology and curator of the Zoological Museum at the University of Michigan, has been appointed a member of the new Philippine Commission. Professor Bernhard Moses, of the chair of political economy of the University of California, has also been appointed a member of the Commission.

The Paris Academy of Sciences has elected as foreign correspondents, Dr. C. Zittel, professor of paleontology in the University of Munich, and Professor Wilhelm Pfeffer, professor of botany at the University at Leipzig.

Dr. A. Smith Woodward, of the Department of Geology of the British Museum, will visit the United States in the spring to study the cretaceous vertebrates in American museums.

Mr. J. B. Woodworth, instructor in geology at Harvard University, has been appointed assistant on the New York Geological Survey to study glacial features of New York. Mr. Woodworth will begin his studies in the lower Hudson Valley in the season of 1900.

Professor O. C. Farrington, of the Field Columbian Museum, has been appointed on the staff of the Commissioner General of the United States to the Paris Exposition, and will spend two months in Paris supervising the installation of the United States mineralogical exhibit.

Dr. Edward Ehlers, of Copenhagen, will go next month to Crete to make arrangements for the segregation of the lepers on the island. There are about 2000 of these and they will be placed on a small island off the north coast.

It is announced in *Nature* that Dr. C. L. Griesbach, the director of the Geological Survey of India, has gone for a tour in the famine districts of the Central Provinces, Bombay and Rajputana, with a view to examining into the practicability of sinking artesian wells.

The Faculty of Medicine, of Würzburg, has awarded its Rinecke Prize of 1000 Marks and a silver medal to Professor J. v. Kries, for his researches in physiology.

The adjudicators of the Hopkins prize, University of Cambridge, for the period of 1891–94, have awarded the prize to W. D. Niven, M.A., F.R.S., formerly Fellow of Trinity, for his memoir on 'Ellipsoidal Harmonics' (*Philosophical Transactions*, 1891) and other valuable contributions to applied mathematics.

We regret to record the death of Dr. Oliver Payson Hubbard, in New York City, on March 9th. He was born in Pomfret, Conn., in 1809 and graduated from Yale University in 1828. He acted as assistant to the elder Silliman whose daughter he married. He was appointed professor in Dartmouth College in 1836, having charge of chemistry and geology, and has since 1883 been emeritus professor. Dr. Hubbard was one of the founders of the American Association for the Advancement of Science.

Professor F. L. Harvey, who held the

chair of natural history in the University of Maine, committed suicide on March 6th. Mental depression resulting from overwork is assigned as the cause. He was born in 1850, graduated from the Iowa Agricultural College in 1868 and was appointed professor in the University of Maine in 1886. He was also botanist and entomologist to the Maine Experiment Station.

THE death is announced of Senator Beltrami, professor of mathematical physics in the University of Rome and president of the Accademia dei Lincei.

HERR DAIMLER, the inventor of the motor car bearing his name, has died at the age of 66 years. His gasoline motor may be regarded as the starting point of the automobile.

PROFESSOR E. B. FERNOW of Cornell University, lectured at Lehigh University on March 9th, his subject being 'The Evolution of the Forest.'

MR. H. F. NEWELL, hydrographer of the United States Geological Survey, delivered an address before the Engineering Society of Harvard University, on March 7th, on the investigations being made by the division of hydrography.

A BRONZE medallion with a relief portrait of Pasteur has been placed on the house in Strassburg in which he lived in 1852.

MR. CHARLES WHITEHEAD, who has acted as technical adviser to the British Agricultural Department of the Privy Council, and subsequently to the Board of Agriculture, during the past fifteen years, has been compelled to resign that appointment owing to ill health.

DR. FRIDTJOF NANSEN expects to leave Christiania on May 15th in a specially constructed vessel to carry out hydrological investigations around Iceland for the Norwegian Government. The expedition will return in the autumn.

THE case of Professor Neisser, of Breslau, accused of making vaccination experiments on human subjects, was again brought up in the Prussian Diet last week. It was reported for the Minister of Education, that the question had been taken up by the state attorney, but that prosecution was barred by the statute of limitation. Disciplinary proceedings were, however, in progress.

WE have already noted that Mrs. Caroline Brewer Croft bequeathed $100,000 for researches into the cause and cure of cancer. This bequest was originally made to Drs. H. K. Oliver and J. C. Warren. They have turned over the bequest to Harvard University, and the medical school has organized the work to be prosecuted. Dr. E. H. Nichols, '86, goes to Europe to study cancer abroad.

IN 1891 Mr. J. W. Charles de Soysa offered a bacteriological institute for Ceylon, but his gift was at the time declined. The offer was, however, repeated in 1897 and then accepted. The Institute, which is very well equipped, was opened by the Governor on January 31st. Dr. Marcus Fernando has been appointed the first director.

THE Brooklyn Institute of Arts and Sciences has been granted an appropriation of $300,000 for the erection of a new wing for the Museum.

THE estimates for the British Museum have been reduced £1000 for the coming financial year, but the trustees have petitioned Parliament to reconsider this decision.

A COLLECTION of Irish antiquities, formed during the last seventy years by Mr. T. R. Murray, of Edenderry, has been acquired for Cambridge University by Professor Ridgeway.

THE Ithaca *Daily News*, for March, 6th devotes a number of columns to the publication of letters from leading naturalists and educators, advocating the establishment by the New York Legislature of a State Biological Station.

MR. R. HORTON-SMITH, Q.C., M.A., of St. John's College, Cambridge, has offered to the University a fund of about £600 for the establishment of a prize for medicine and pathology, in memory of his son Raymond Horton-Smith, M.B., who, after a distinguished career in the university and at St. Thomas' Hospital, died in October, 1899, in his 27th year. The prize is to be awarded annually for the best thesis for the M. D. degree offered by candidates who have taken honors in one of the Triposes. The prize thesis is to be printed, and copies are to

be sent to various officers and libraries of the university and the Royal College of Physicians.

THE late Professor D. E. Hughes bequeathed £400 to the Paris Academy of Sciences for the establishment of a prize for the most important discovery in physical science, preference being given to a discovery in electricity or magnetism.

UNDER the direction of Professor A. A. Wright of Oberlin College, systematic excavation has been commenced in Brownhelm, Ohio, near Lake Erie and about twelve miles from Oberlin, to recover mastodon remains, the first of which were discovered several years ago. The jaws and head, both tusks, together with a number of ribs and vertebræ have been obtained in a good state of preservation. The bones are much scattered and lie upon a clay hardpan at the bottom of a muck bed four feet deep.

THE Royal Meteorological Society, London, will celebrate its 50th anniversary on April 3d. The Council has arranged for a commemoration meeting to be held at 3 p. m. at the Institution of Civil Engineers, at which the president will deliver an address, and delegates from other societies will be received. In the evening a *conversazione* will be held at the Royal Institute of Painters in Water Colors. On the following day, April 4th, the Fellows will visit the Royal Observatory, Greenwich, and in the evening will dine together at the Westminster Palace Hotel. In view of this jubilee celebration, Mr. G. J. Symons, F.R.S., was elected president at the annual meeting of the Society on January 17th, but owing to illness he has since been obliged to resign this office. Under these circumstances the Council at their last meeting appointed Dr. C. Theodore Williams as the president of the Society.

THE Committee of the Liverpool School of Tropical Diseases has decided to send out next month, under the direction of Dr. Annett, another expedition to West Africa. The expedition will make its headquarters in Old Calabar and carry on researches in southern Nigeria. If time and opportunity permit the upper Niger will be visited.

AT a meeting of the British Astronomical Association on February 28th, Mr. Maunder announced that sufficient names had not been handed in to justify chartering a steamship to visit the Mediterranean at the time of the solar eclipse in May. A large number of names had been withdrawn owing to the war.

THE United States Civil Service Commission announces that in view of the needs of the service all persons who have been examined within the past six months and have failed to attain eligible averages in the following named examinations will be permitted re-examination this spring upon filing new applications. These examinations will be held at various places throughout the country, beginning April 17, 1800: Acting Assistant Surgeon Marine Hospital Service, Aid Coast and Geodetic Survey, Assistant Department of Agriculture, Assistant Examiner Patent Office, Assistant Topographer, Civil and Electrical Engineer, Copyist Ship Draftsman, Farmer, Fish Culturist, Hospital Steward, Industrial Teacher, Meat Inspector, Kindergarden Teacher, Manual Training Teacher, Matron, Mechanical and Electrical Engineer, Physician, Register and Receivers Clerk, Seamstress, Superintendent of Construction, Surveyor General's Clerk General Land Office Service, Teacher, Topographic Draftsman, Trained Nurse.

AN International Congress of Medical 'Electrology and Radiology' will be held at Paris from the 22d of July to the first of August. Professor Weiss of the University of Paris, is president and the general secretary is Professor Doner, University of Lille.

THE Italian Government has decided to establish a bacteriological laboratory for the study of bubonic plague in the island of Pianosa.

WE learn from the *British Medical Journal* that M. Fleury-Ravarin, Member of the Chamber of Deputies for the Rhône Department, has brought in a bill providing for the creation of a national antituberculous institute. The proposed institute is to be devoted to the study of the treatment of tuberculosis and experimental researches on the means to be employed for that purpose. The Société Lyonnaise des Tuberculeux Indigents has undertaken to build the institute at its own cost, and proposes to make it an annex of the free sanatorium which it is about to open at Hauteville, in the mountains

of the Bugey district. M. Fleury-Ravarin asks the State to associate itself with this philanthropic work by conferring on the institute the title of 'National,' and granting it an annual subvention of £600.

A MEETING of the Organizing Council of the British Congress of Tuberculosis was held at house of the Royal Medical and Chirurgical Society on February 22d.

THE plague has appeared in Sydney, New South Wales, and on the Island of Cozumel, off the coast of Yucatan. A case has occurred in San Francisco. Deaths are still reported from Honolulu. There is no abatement in India, the deaths at Calcutta being 411 for the last week of which news is at hand.

RECENT issues of the *British Medical Journal* and *Nature* recommend the appointment of Professor William Osler, of Johns Hopkins University, to the chair of the practice of physic, vacant by the death of Sir Thomas Grainger Stewart. *Nature* says:

> The desire has been widely expressed in University circles in Edinburgh that the Curators of Patronage, with whom the appointment to the chair of medicine rests, should offer the post to Professor Osler, of the Johns Hopkins University, who is well known as a teacher and clinicist of the highest scientific eminence, and whose acceptance of it would greatly strengthen both the systematic and clinical teaching in the University. It would appear, however, that the Curators have no choice in the matter, but are bound to advertise every vacancy, so that the far more satisfactory and dignified method of appointment by invitation is necessarily excluded. Nevertheless, it is confidently hoped that Professor Osler may be induced to send in a formal application for the chair, since it is certain that his claims would receive every consideration from the present Board of Curators, who have more than once, on recent occasions, shown that they are superior to merely local considerations, and that they have regard in making these appointments solely to the best interests of the University. Professor Osler is a Canadian by birth, and although he has for many years successively occupied the important chairs of medicine in Philadelphia and Baltimore, he has, we believe, never renounced his British nationality. His appointment to Edinburgh, although it would be felt as a serious loss by our kinsfolk on the other side of the Atlantic, would doubtless be considered by them, and especially by our Canadian fellow-subjects, as a graceful recognition that we are one people bound together in science, as in politics, by common interests, and that we are prepared to welcome the best man from whichever side of the water he may hail. Applications for the post, with testimonials, must be lodged with Mr. R. Herbert Johnston, Secretary to the Curators, at 66 Frederick Street, Edinburgh, on or before April 14th."

IN his annual report President Eliot writes of the observatory: "The director reports that the Harvard Observatory, which in 1892 had the second largest income among the great observatories of the world, in 1898, had only the fifth largest, the observatories at Washington, Paris, Greenwich and Pulkowa surpassing it in income and expenditure. This fall is occasioned by the decline in the rate of interest on the funds of the observatory. The observatory is now so well organized and so active and efficient that it will be a great pity if its resources, and, therefore, its powers of usefulness, are permitted to decline. It is the only observatory which maintains a station in the northern hemisphere and in the southern; and its collection of photographs of the entire sky gives it unique means of studying the recent history of the stellar universe. The photographic plates are now kept in a fireproof building; but the library of the observatory, which has become very valuable, is in a wooden building and is, therefore, exposed to complete destruction by fire. A fireproof building, which need not cost more than $15,000 or $20,000, ought to be provided for the safe keeping of this collection." Four volumes of the *Annals* have been in process of publication during the larger part of the year, and more than 30 volumes of the *Annals* have been published during the last 20 years—a rate of publication that is truly astonishing. "On November 28, 1898, Mrs. Williamina Paton Fleming was appointed Curator of Astronomical Photographs, and in that capacity her name appeared in the university catalogue for 1898–99. It is believed that Mrs. Fleming is the first woman who has held an official position in Harvard University. She is well known to astronomers as the discoverer of a remarkable number of new variable stars."

MR. SIMON W. HANAUER, Vice-Consul of the United States at Frankfurt, writes to the Department of State that nothing has been said of

the San José scale for months in German papers. It has not yet made its début in a live condition in Germany, thus confirming the opinion of experts that the climatic conditions of Germany are not suited to its perpetuation; but, while the false alarm concerning the introduction and ravages of the San José scale has vanished, its ill effects in the nature of administrative measures against the import of American fruit have continued, and the hardship of these proscriptive ordinances are making themselves so acutely felt that German trade circles and consumers are beginning to protest. The chamber of commerce of the city of Hamburg (one of the most important trade bodies of Germany), in its lately published annual report, says on this subject: "The station which last year was opened in this city for the purpose of investigating the presence of the San José scale on American fruit has a laboratory where two scientifically trained experts, with fourteen assistants, have steadily pursued these investigations in the most circumspect manner. While there may not be any objection to examining 'raw fruit,' the continuation of investigations in regard to 'dried fruits' must be considered an utterly unnecessary hindrance to trade. The sanitary experts, whom the imperial German department of health, as well as the Belgian Government, sent last year to California, have fully confirmed the statements made by German fruit importers that the drying methods in use in the United States effectually kill the insects. Therefore, the scales found on dried fruit from America were dead. The trade suffers great damage from the examination, stricter here than elsewhere, and this chamber of commerce regrets that this unnecessary annoyance and harmful practice was not at once discontinued when the facts became known."

UNIVERSITY AND EDUCATIONAL NEWS.

New York University has received a gift of $100,000—it is reported from Miss Helen Gould—for the erection of a 'Hall of Fame for Great Americans.' Colonades overlooking the Harlem river will be erected containing 150 panels on which will be engraved inscriptions commemorating eminent Americans.

Columbia University has received from Mrs. Robert Goelet the gift of a bronze statue to cost about $25,000. It will represent 'Alma Mater' and will be erected in the court before the library.

Oberlin College has received a gift of $50,000 from Dr. and Mrs. Lucien C. Warner, of New York, for a men's gymnasium.

A bequest of £20,000 has been made to the New College, Hampstead (now a constituent college of London University), under the will of the late Mr. Henry Vaughan.

A daughter of the late Professor Hughes Bennet, of the University of Edinburgh, has offered the University a sum of money to establish an addition to the physiological laboratory for the purposes of research.

The Chicago College of Physicians and Surgeons was three years ago affiliated with the University of Illinois. An agreement has now been made effecting a more complete consolidation which is to last 25 years, and allowing the University of Illinois to secure complete control of the College.

Dr. Harris Hancock, A.B. (Virginia and Johns Hopkins) and Ph.D. (Berlin), has been elected professor of mathematics at the University of Cincinnati to fill one of the chairs recently declared vacant by the Board of Directors. Dr. Hancock has published papers on the Abelian functions, on the calculus of variation and other subjects. He is at present at Paris.

At Oberlin College, Simon F. MacLennan has been appointed professor of psychology and pedagogy, and Frederick O. Grover, professor of botany.

Professor R. S. Lawrence, of Emporia College, Kans., has accepted the chair of mathematics in Hanover (Ind.) College.

Professor Julius Hann, of Gratz, has been called to the professorship of cosmical physics, at Vienna. Dr. August Gutzmer has been made full professor of mathematics in the University of Jena. Dr. v. Schmidt, of Dorpat, has qualified as docent in histology and embryology in the University at Jena.

Dr. Th. M. Fries, professor of botany in the University of Upsala, has retired.